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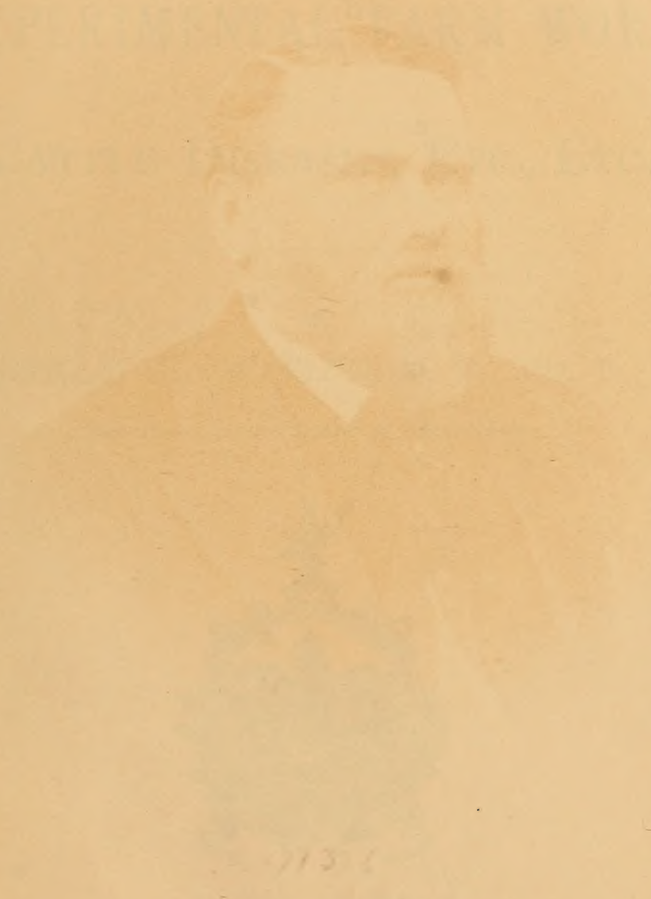

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THE FORESTS OF VERMONT, SUGAR MAPLE INDUSTRY, EXPERIMENTAL FARM WORK, CATTLE DISEASES, ETC., ETC.

BY

HIRAM A. CUTTING, M. D., PH. D.,

SECRETARY OF THE BOARD OF AGRICULTURE.

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THE FORESTS OF VERMONT,

Considered in relation to Rain-fall, effect upon Climate and Profit in Tree Culture.

That there is a connection between forest area, and the distribution and amount of rain-fall, no one at the present day will question. In the world at large this opinion is supported by so many well known facts, and so many critical observations. as well as by general history, that it leaves no reasonable doubt. But when we come to our own country, and more particularly to New England there are some found who think that the future will take care of itself and their interests being largely in timber lands, their desire to cut the same for their immediate profit leads them to say, and perhaps often believe, that small areas make no perceptible difference in results. Having made the most minute observations upon the wind and rain-fall I most sincerely believe they are often affected by even small areas of timber land; often by as small a tract as one thousand acres. Of course there must be some general principle underlying the whole and I believe that to be that the atmosphere in and around a forest is cooler than over cultivated fields, and that the cooler air rising from a forest often retains, by condensation into clouds that fall in showers, moisture that otherwise would pass over without precipitation. Among our hills there seems to be what we might call paths for showers and certain hills and certain valleys are sure to get more than their share.

Now in my records I find that those paths have changed considerably during the last forty years, and that such change has seemed to be brought about by the change in timber area. Some hills formerly wooded that received abundant showers, now denuded do not lie in their usual path and hence the streams and springs of that section have failed or dried up, when formerly perennial. The change in the forests in this section have seemed to send the path of showers toward the highest of the White Mountains of New Hampshire, Mount Washington more especially, and hence the summer rain-fall has greatly increased there, while it has almost equally decreased here. References to the accompanying tables will at once convince you that such seems to be a fact. Certainly something has effected the change and as our forest area has been greatly diminished there seems a cause while everything else, as far as we can know, remains the same.

Hon. Benj. A. Willis, of New York, says that the distribution of water supply, if not the amount, is beyond doubt affected by the forests; that their existence is indispensable to public health; that they are needful to preserve the supply of our rivers, and to protect our fields and cities from floods, desolation and destruction.

Hon. Franklin B.Hough says that this growing tendency to floods and droughts can be directly ascribed to the clearing up of woodlands, by which the rains quickly find their way into the streams, often swelling them into destructive floods, instead of sinking into the earth to re-appear as springs. Aside from the direct efforts of shelter and shade afforded by trees, the evaporation of rain-drops that fall upon the leaves, and the chemical action of the leaves themselves, have a marked influence upon the humidity and temperature of the air beneath and around them. The contrast, in a very dry season, between an open and sunburnt pasture, and one interspersed with clumps of trees, must have been noticed by every careful observer, and the actual relative profits of farms entirely without trees, and those liberally shaded, (everything else being equal,) will show, at least in grazing districts, the advantage of the latter in the value of their annual products. The fact that furniture in houses too much shaded will mould is a familiar and suggestive instance of the humid influence of trees, and the aggregate results of woodland shade may well explain the fullness of streams and springs in the forest, which dry up and disappear when it is removed.

Hon. Warren Higley, of New York, President of the Forestry Congress, says: There is abundant evidence in America of the effects of the cutting off the forests. In Central New York streams that thirty or forty years ago kept the ponds well filled for the saw-mill and grist-mill, and furnished a never-failing supply of running water for the farm, are now dry in summer, with the exception of here and there a stagnant pool; the dam is decayed and washed away, the mills gone, and the once picturesque scene is changed to that of desolation. Yet, with the warm rains of spring and the melting snows, the streams overflow their banks, the swift waters carry away fences, bridges, and embankments. Spring opens later. The young cattle were wont to be turned into the wood-sheltered pasture about the first of April; now they are kept shut up until the middle of May. Peach orchards that were sure to be loaded every year with luscious fruit have almost disappeared, and the crop is the exception rather than the rule. The extremes of heat and cold are greater, and droughts in summer and floods in spring-time are more frequent and more destructive. Trace the stream from its source and the cause of these things is apparent. The old tamarack swamp that used to supply the boys and girls with aromatic gum, and in which the creek had its source, has all been cut away. The thickly wooded black-ash swamps, through which the stream ran in its course to the lake, have been cleared, and their marshy areas have given place to cultivated fields and pastures. The cutting away the forests from the head-waters and the banks of this stream accounts for the changes I have noted, and this picture, I doubt not, is a very familiar one in the New England and Middle States. It is not difficult for men who know the effects of cutting the timber from small areas around the head-waters of the smaller streams to understand why summer navigation in the Mississippi, the Missouri, and the Ohio has become difficult and at times impossible where it was easy and constant a few years ago; or why the Hudson and the Connecticut are much lower in summer and higher in spring than in former years. The partial deforesting of the Adirondack region has materially affected the flow of the Hudson, the Mohawk, the Black, and other rivers, and sufficiently demonstrated the fact that were this great watershed of New York stripped of its forest covering, the Empire State would lose her prestige and New York city her rank as the first commercial city of the new world.

Under a joint resolution of our legislature in 1882, Gov. J. L. Barstow appointed a commission to inquire into the subject of forestry evils in Vermont and to suggest remedies. This commission addressed circulars, asking questions relative thereto, to the representatives, selectmen, listers, postmasters and many prominent men in the State and in its report it says: The answers to questions in regard to the effect of the removal of the forests upon the springs, streams and ponds of the state, with scarcely an exception, tell the same story: that the water supply is year by year failing, and that the smaller springs and streams which had never until recently been known to fail often become totally dry in a dry season. The replies to this question are more full and specific than to any other. A very few say they notice no changes. Only two of the several hundred express the positive opinion that there is no change in their vicinity, and very many over all parts of the state give facts in detail which are certainly of a very alarming character. It is evident from the replies that this phase of the question is the one which has engaged the attention of the people and excited more universal interest than any other. These changes are generally admitted to be the greatest of the many evil results of the devastation of our forests.

There are many specific statements of the diminution of the water supply in particular streams within a certain number of years; of mills without power; of good trout brooks of fifty years ago now nearly dry in summer; with other statements of interest, and the main fact remains that our water supply is, at least, more erratic and fitful and in many places smaller, during the necessary season for the growth of crops, than formerly.

At Lancaster, New Hampshire, on the Connecticut river, an old resident reports "an alarming decrease in the water of the streams and springs during the past sixty years, and especially during the last twenty-five years, within which period the smaller timber also has been removed. Israel's River in my boyhood was a large mill-stream eight or ten rods wide, with sufficient water to carry a very large amount of machinery the year round. Now it is an insignificant stream, with, from May to November, not more than half the water it had fifty years ago, and not more than two-thirds it had twenty-five years since. Other streams have suffered in the same way, and the springs have, if possible, suffered more than the streams. Many, once thought to be never-failing, are now for long periods dry. That the cutting off of the forests accounts very largely for this change I consider as sure as that effect follows cause, and the result is hastened by the reckless methods in use. Instead of cutting timber that is matured, everything is cut to the size of five or six inches in diameter, and what remains is cut into fire-wood, or burned at once, leaving a dreary waste. In Lancaster the timber and wood are nearly all gone, and the mountains are being stripped to their summits."

The Forestry Commission of New Hampshire, says: "Certain *local* effects are unquestioned, and come under daily observation. Extensive clearings in the vicinity of many of our farm-houses and villages have brought about changes that prove anything but advantageous, adding in many ways to the rigor of our climate, and rendering such localities less desirable for residence than formerly. Trees may not be so much needed by us for shelter and protection as on a Western prairie; but the treeless hilltop or hillside is certainly less favorable for our cattle and our crops, our orchards and our gardens, for health, and even for home comfort, than the same location would be with sheltering belts of timber to break the force of storm in winter, and to check the drying influence of the wind throughout the year. We may call these changes local if we will, and believe their effect on atmospheric conditions will be as difficult to determine in the future as in the past; but let these changes go on for a generation or two longer as they are now going on, becoming general instead of local, and who doubts their effect on both climate and rain-fall, as well as water-supply? Again: It may be said that the forest area of our state is too limited in any case to have much influence on our climate and rain-fall, since both are controlled by conditions covering a much wider area of territory. But when the woodman's axe is as busy as it now is east and west, north and south of us, we cannot fail to see that injurious changes are coming, greater than any as yet experienced, and that our best, perhaps our only, means of protection against them, as they may still further affect climate, rain-fall, and water-supply, is the more prudent management of our forestry interests."

As the watering of the land is by evaporation from the ocean which evaporation is the same each year or else the ocean would soon overflow the low land, it can be asserted, and often is, that the aggregate rain-fall is the same and this may be true and yet our field crops perish by drought. Note what I have said about showers and much the larger part of our rain-fall during summer is from showers. That wooded hill-tops have abundant rain does not help our summer crops in valleys. In July 1884 we received two and one-half inches of rain from showers and Mount Washington twenty-three inches yet observation shows, and our school books teach, that where the country is all wooded the summits of mountains do not receive as much rain-fall as the valleys.

Is there not a lesson in this? The rain-fall is increasing on the summit of the White Mountains but decreasing in the cultivated valleys. Hence you see that while the same number of gallons of water may every year fall in the United States, it may become even too arid to cultivate, as the bleak and desolate mountains may be deluged and severe showers prostrate our crops and destroy our meadows. Yet the same amount of water will fall somewhere. It is the steady rain without wind that is wealth to the husbandman and that a reasonable restoration of forests will doubtless provide. The following deduction as made from tables furnished the New Hampshire Forestry

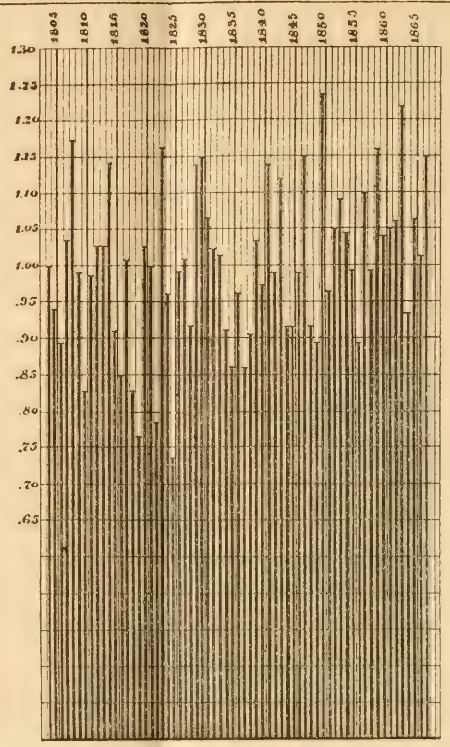

DIAGRAM I.
Fluctuations in Annual Rainfall on the Atlantic Sea-coast, Maine to Maryland; from Smithsonian Rain Table, by C. A. Schott.

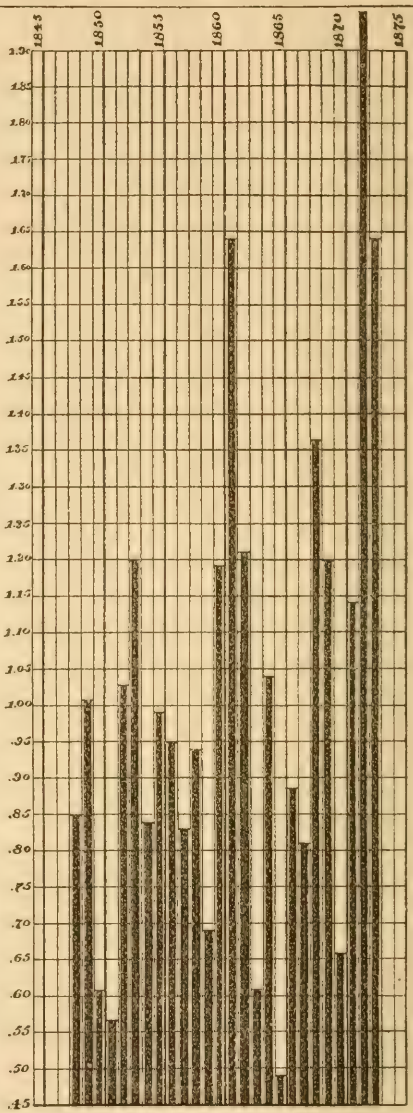

DIAGRAM III.
Fluctuations in Snowfall of the Upper Connecticut Valley; from Observations by H. A. Cutting, M.D., Lunenburg, Vt.

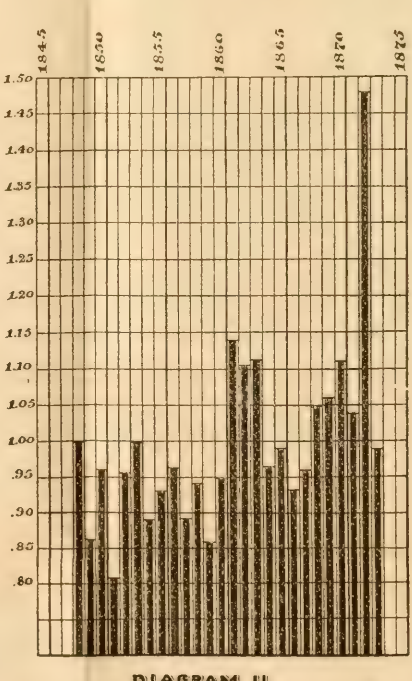

DIAGRAM II.
Fluctuations in Annual Rainfall of the Upper Connecticut Valley; from Observations by H. A. Cutting, M.D., Lunenburg, Vt.

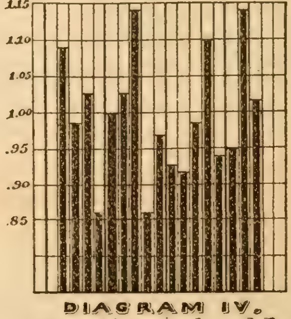

DIAGRAM IV.
Fluctuations in Annual Rainfall at Lake Village; from Observations by the Winnipiseogee Lake Company.

Commission I submit; with some of the tables and chart of the deductions therefrom, and also complete tables of observations at Lunenburgh. The graphical chart also gives the record of Mr. Hazen Doton, of Woodstock. This chart is worthy of careful study.

The observations made at Lunenburgh, Vt., it will be seen, cover a series of thirty-eight years, and give an average of 40.03 inches of rain yearly, between the extremes of 31.14 inches in 1880 and the unusual amount of 60.91 inches in 1872, when more than twelve inches is recorded in the single month of August. Twenty-four of the above thirty-eight years fall below the average, but the larger portion of these years of deficiency are in the first half of the period, and not in the last half. Again, dividing the series into seven periods of five years (beginning for convenience with 1850), it is the first two periods and the last which fall below the average; the remaining four periods, coming down to 1879 and near the present time, are all above the average, and two of them very much above it. The years 1880 to 1884 inclusive, give an average rain-fall of only 34.78 inches, and mark a time of decided drouth. 1885 is below the average being 37.47 inches, and this year will be below also.

The average rain-fall at Hanover, New Hampshire, for the last fifteen years (all that have a complete record in the table) is only 30.05 inches, which is in striking contrast with the record at Lunenburgh, about 75 miles further north, it being 10 inches greater. Here, too, the average for the last five years indicates a decisive falling off, but not a falling off suggested of necessity by the two five-year periods that precede. The same statements are true as to the record of observations made at Woodstock, about eighteen miles from Hanover, New Hampshire. The average rain-fall of 36.73 inches drops suddenly to 32.51 inches during the last five years.

At Weirs the annual average for twenty-five years has been 43.12 inches; and here again the average is well maintained, until the dry period from 1880 to 1885 is reached.

At Concord, New Hamphire, during the same twenty-five years, the average is 39.17 inches. All but the last of the five-year periods exceed the average, varying from 44.05 inches for the first period to 33.11 inches for the last, and showing a very slight decrease from period to period. The twenty-years record furnished by the late Mr. Tufts, of Dover, New Hampshire, are not entirely complete, but as it stands it also shows a gradual diminution of rain-fall, with the same abrupt falling off of the record during the recent years of widespread drouth.

On the other hand the observations on Mount Washington, New Hampshire, show a decided increase. Observations in Europe and elsewhere show less rain-fall upon mountain tops when the valleys are wooded but so far as I can get reliable information all observations seem to coincide of the increase of rainfall on mountains while the removal of timber causes decrease in valleys.

That you can see just how it stands I publish comparative observations between Lunenburgh and Mount Washington, in a table following the series at Lunenburgh.

TABLE I.

Amount in inches of monthly rain-fall (including melted snow) at Lunenburgh, Vt.

Y'rs.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.	Yearly totals.	Snow in winters.
1848	2.68	4.75	3.60	1.12	2.72	1.84	4.20	3.82	1.10	5.84	3.38	5.95	41.00	71.00
1849	2.25	3.85	6.10	2.22	2.47	2.00	4.00	1.75	2.20	2.25	3.71	3.00	35.80	84.00
1850	2.90	3.95	4.50	2.00	3.50	1.75	3.90	4.00	2.05	4.90	3.50	3.05	40.00	52.00
1851	4.00	1.15	3.50	7.10	.85	3.60	4.18	1.25	2.80	3.00	1.50	.57	33.50	48.00
1852	2.75	3.75	4.10	5.25	5.80	4.20	2.75	2.00	3.25	3.75	.45	.95	39.00	86.00
1853	4.	4.55	2.10	2.80	3.10	2.80	4.20	4.50	3.15	2.80	4.00	3.75	41.75	100.00
1854	4.80	3.90	3.25	2.10	2.20	2.50	1.10	.75	3.75	4.20	4.05	4.00	36.60	70.00
1855	1.40	2.25	4.25	3.75	4.70	5.80	3.20	2.50	3.25	2.20	2.00	2.95	38.25	83.00
1856	3.25	3.00	5.20	2.10	2.40	3.75	3.75	3.20	3.00	3.15	3.00	4.00	39.80	79.00
1857	2.60	2.90	4.50	3.00	2.80	3.25	3.50	3.00	2.95	4.18	2.50	2.07	37.25	69.00
1858	3.25	3.00	1.50	4.10	2.50	2.85	2.75	3.50	3.25	3.80	5.00	3.00	38.50	75.00
1859	1.07	2.05	4.25	1.25	2.75	4.00	2.25	3.06	4.50	2.50	2.85	4.77	35.30	58.00
1860	2.25	2.16	1.98	1.56	1.50	1.06	3.62	9.06	4.52	2.32	5.37	3.50	38.90	99.00
1861	3.20	3.00	2.95	5.85	6.75	4.00	6.00	1.75	5.00	4.62	2.18	1.70	47.00	147.00
1862	3.80	5.02	3.56	2.40	1.75	1.70	2.75	6.00	4.00	4.00	6.75	4.07	45.80	101.00
1863	5.45	1.40	4.70	2.85	4.50	1,50	8.70	2.90	3.05	3.60	2.25	5.10	46.00	51.00
1864	2.63	1.88	2.92	1.90	6.85	1.32	2.00	3.30	2.75	6.12	3.70	3.65	39.02	87.00
1865	3.35	1.70	5.13	3.35	6.55	2.75	3.92	1.00	4.62	3.35	2.95	1.02	39.69	41.00
1866	1.55	3.35	1.40	2.50	2.00	3.00	6.00	5.25	6.00	1.95	3.25	1.85	38.10	73.00
1867	2.05	4.30	2.60	2.70	9.47	3.75	3.33	3.75	2.00	1.50	2.45	1.75	39.65	68.00
1868	1.87	1.45	2.80	1.30	5,75	4.40	5.05	1.83	8.02	1.30	7.15	2.45	43.37	114.00
1869	4.30	4.12	4.45	2.05	2.85	5.00	2.75	2.50	2.60	8.10	2.21	3.02	43.95	100.00
1870	4.55	4.00	1.47	2.50	3,60	3.50	4.34	6.42	3.00	3.95	6.52	1.30	45.65	55.00
1871	3.15	2.10	3,65	5.72	3.62	2.12	4.35	7.35	2.30	3.90	1.00	3.70	42.96	95.00
1872	2.00	3.05	2.70	2.00	8.20	7.33	7.25	12,58	3.48	2.27	5.05	5.00	60.91	167.00
1873	3.85	3.35	4.50	2.65	2.64	2.00	3.95	2.50	4.75	5.45	2.22	2.65	40.51	117.00
1874	3.70	1.80	2.25	4.05	2.95	7.06	4.98	4.38	1.35	1.15	2.71	3.07	39.45	107.00
1875	3.60	4.03	3.00	2.85	3.73	5.70	2.55	3.45	4.35	5.26	2.92	1.40	42.84	103.00
1876	3.55	3.60	3.00	2.75	4.70	7.05	5.22	1.35	5.94	1.50	1.67	2.82	43.15	70.00
1877	2.15	.65	6.40	2.35	1.05	3.00	4.22	5.95	2.05	4.70	3.65	1.87	38.04	32.25
1878	1.65	.80	2.25	6.15	2.45	4.65	3.35	4.45	1.20	2.60	2.70	2.30	34.55	103.00
1879	3.45	2.75	3.15	2.70	1.45	5.80	5.00	4.67	3.78	2.20	4.18	4.30	43.43	71.75
1880	2.25	2.60	1.47	1.40	3.05	2.30	2.45	3.79	2.40	4.70	2.18	2.55	31.14	191.00
1881	2.90	1.70	2.60	1.00	4.55	2.20	3.09	2.75	2.45	4.85	5.19	4.92	38.20	117.00
1882	3.75	3.75	1.75	1.55	2.20	4.93	2.85	1.05	5.26	1.45	1.27	2.40	32.21	113.00
1883	2.10	3.65	2.40	1.30	4.00	4.34	4.80	1.18	2.90	4.50	2.83	2.60	36.60	116.00
1884	3.30	2.30	4.60	1.26	4.45	1.95	2.50	2.55	2.55	5.00	2.50	2.80	35.76	104.50
1885	3.40	2.35	2.25	.60	1.00	3.88	6.46	5.77	3.00	4.51	2.55	1.70	37.47	60.25
1886	2.65	1.67	.90	.75	2.37	1.70	2.32	4.70						
Av'ge	3.01	2.89	3.34	2.74	3.61	3.54	3.98	3.70	3.38	3.61	3.23	2.94	40.03	

CONCORD. WEIRS. HANOVER.

GRAPHICAL CHART OF VARIATIONS IN RAIN-FALL.

FROM NEW HAMPSHIRE FORESTRY REPORT.

[The figures at the left indicate *inches*, and the broken line the *mean*, at each place.]

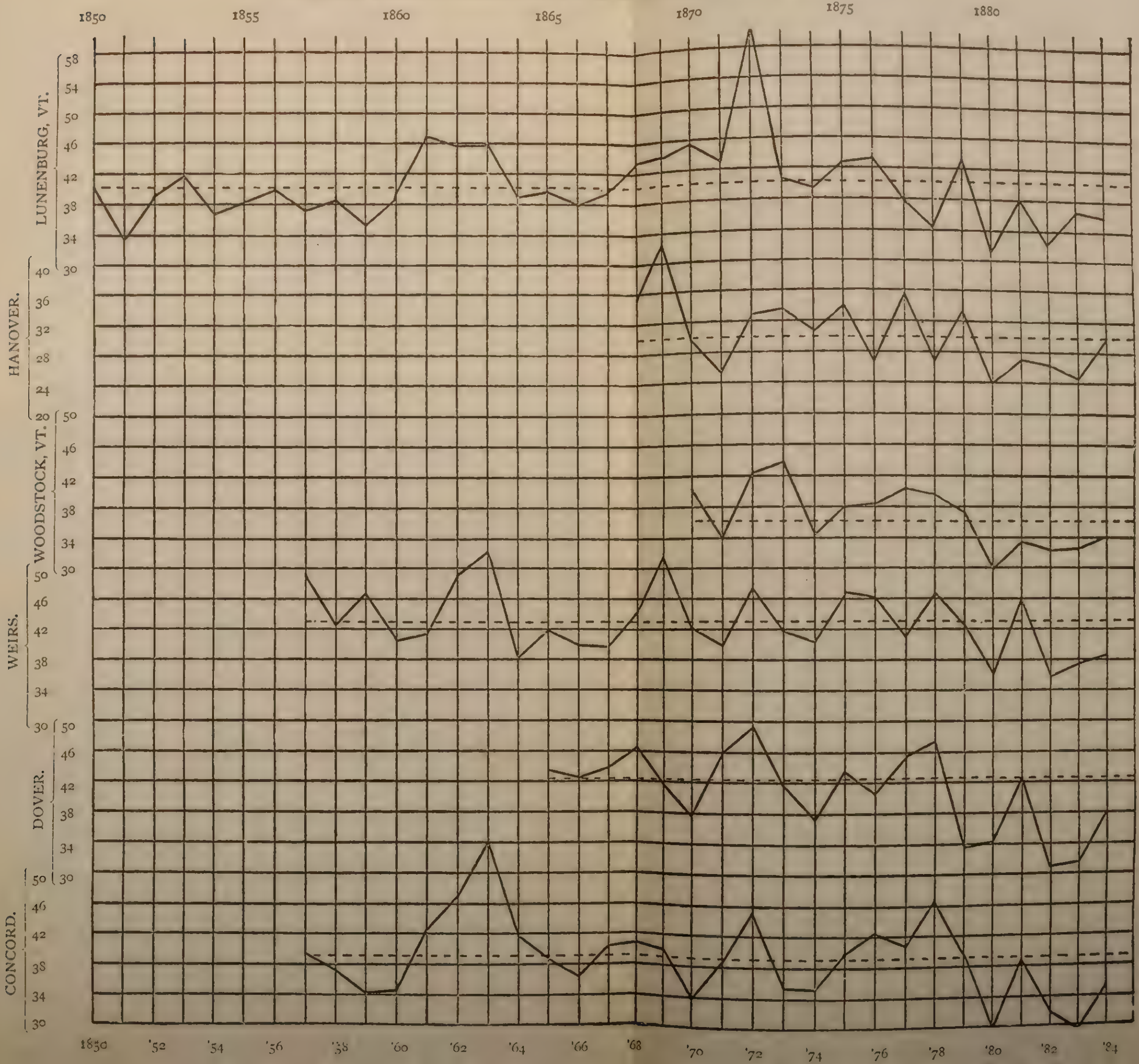

TABLE No. 2.—COMPARATIVE PRECIPITATION BETWEEN TOP OF MT. WASHINGTON, N. H., AND LUNENBURGH, VT.

Compiled from observations of U. S. Signal Station, Mt. Washington, and mine at Lunenburgh, from Jan. 1, 1872, to Sept. 1, 1886.

Place.	Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Amount of annual rainfall.
Mt. Washington.....	1872	1.67	.30	.89	.07	4.69	18.46	3.59	6.41	9.56	5.53	4.01	1.38	56.56
Lunenburgh	1872	2.00	3.05	2.70	2.00	8.20	7.43	7.29	12.58	3.48	2.27	5.05	5.00	60.91
Mt. Washington.....	1873	3.39	5.20	5.81	2.72	4.55	3.26	13.54	5.81	13.66	9.23	5.50	5.95	78.62
Lunenburgh	1873	3.85	3.35	4.50	2.65	2.64	2.00	3.95	2.50	4.75	5.45	2.22	2.65	40.51
Mt. Washington.....	1874	4.40	2.47	6.71	5.74	6.53	13.44	7.94	9.51	5.52	2.96	2.34	3.07	70.59
Lunenburgh	1874	3.70	1.80	2.25	4.05	2.95	7.06	4.98	4.38	1.35	1.15	2.71	3.07	39.45
Mt. Washington	1875	1.82	1.00	2.13	2.00	2.50	6.83	7.40	7.95	11.34	6.30	2.67	3.84	55.78
Lunenburgh	1875	3.60	4.03	3.00	2.85	3.73	5.70	2.55	3.45	4.35	5.26	2.92	1.40	42.84
Mt. Washington.....	1876	2.80	3.50	6.30	3.12	7.83	9.32	14.51	2.20	14.89	3.21	3.49	6.48	77.65
Lunenburgh	1876	3.55	3.60	3.00	2.75	4.70	7.05	5.22	1.35	5.94	1.50	1.67	2.82	43.15
Mt. Washington.....	1877	2.06	.33	11.64	3.40	3.72	8.78	11.27	11.11	2.79	7.75	17.55	6.01	86.41
Lunenburgh	1877	2.15	.65	6.40	2.35	1.05	3.00	4.22	5.95	2.05	4.70	3.65	1.87	38.04
Mt. Washington.....	1878	8.54	5.88	10.66	23.41	9.28	7.67	11.00	11.35	7.36	5.78	4.78	8.77	114.48
Lunenburgh	1878	1.65	.80	2.25	6.14	2.45	4.65	3.35	4.45	1.20	2.60	2.70	2.30	34.55
Mt. Washington.....	1879	7.13	7.01	7.51	6.71	4.40	11.84	10.23	9.55	6.33	5.03	9.53	5.56	90.83
Lunenburgh	1879	3.45	2.75	3.15	2.70	1.45	5.80	5.00	4.67	3.78	2.20	4.18	4.30	43.43
Mt. Washington.....	1880	4.24	2.56	4.87	3.47	5.51	5.86	7.24	5.82	15.23	7.96	9.37	7.80	79.93
Lunenburgh	1880	2.25	2.60	1.47	1.40	3.05	2.30	2.45	3.79	2.40	4.70	2.18	2.55	31.14
Mt. Washington.....	1881	3.94	6.62	8.51	5.08	12.50	7.03	9.93	11.96	6.13	18.38	15.10	15.95	121.13
Lunenburgh	1881	2.90	1.70	2.60	1.00	4.55	2.20	3.09	2.75	2.45	4.85	5.19	4.92	38.20
Mt. Washington.....	1882	7.20	5.94	14.52	11.20	8.91	11.40	10.03	2.81	13.32	6.19	3.25	2.64	97.41
Lunenburgh	1882	3.75	3.75	1.75	1.55	2.20	4.93	2.85	1.05	5.26	1.45	1.27	2.40	32.21
Mt. Washington.....	1883	4.16	5.65	4.18	6.29	9.10	11.30	11.14	6.06	6.90	5.55	3.72	2.66	76.71
Lunenburgh	1883	2.10	3.65	2.40	1.30	4.00	4.34	4.80	1.18	2.90	4.50	2.83	2.60	36.60
Mt. Washington.....	1884	1.69	7.55	4.16	3.29	9.54	8.08	23.90	8.63	7.58	12.91	7.99	4.70	100.02
Lunenburgh	1884	3.30	2.30	4.60	1.26	4.45	1.95	2.50	2.55	2.55	5.00	2.50	2.80	35.76
Mt. Washington.....	1885	5.49	1.87	.95	2.66	2.29	11.34	11.34	14.26	5.56	11.11	4.67	4.83	76.37
Lunenburgh	1885	3.40	2.35	2.25	.60	1.00	3.88	6.46	5.77	3.00	4.51	2.55	1.70	37.47
Mt. Washington.....	1886	4.85	3.22	3.11	3.36	3.25	6.09	6.30	8.34					
Lunenburgh	1886	2.65	1.67	.90	.75	2.37	1.70	2.32	4.70					
Mt. Washington.....	Average annual rainfall,													84.96
Lunenburgh	“		“	“										39.59

TEMPERATURE.

Forests are notably cooler in summer and warmer in winter than cleared land, and further they are cooler in a clear sunny day and warmer during the ensuing night; hence it can be well understood why the temperature changes as well as the rainfall by the clearing up of a large section. The result is warmer days and cooler nights, as the synulizing effect of the forest temperature is lost. The daily, monthly and yearly means of temperature may show no special change, yet the change will be apparent to the people and to the crops. There will be earlier and later frosts, that are erratic and partial, killing vegetation here and there, though not on high land where the wind is felt, or under shelter of woodland where the breeze is not felt. Almost every person has become aware of these changes without actual observations with instruments, but accurate observers will be assured of such facts if they take the trouble to observe their daily range, though the actual average is nearly as before. An extended series of observations show some discrepancy, however, as the following tables will disclose. While the average temperature of the year is about as usual, the average monthly temperature is more erratic; yet, as I before remarked, it is this daily range that seems most effectual, and yet doubtless the yearly mean will in a series of years be found to average lower if figured as now.

TABLE NO. 3.

OBSERVATIONS ON TEMPERATURE OF LUNENBURGH.

Latitude, 44° 27′ 43.″ Longitude, 71° 40′ 47.″ Elevation. 1210 feet.

Year.	Average monthly Temperature in degrees and hundredths.												Yearly Means.
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
1848	19.50	17.00	30.40	41.30	50.00	67.65	70.30	69.25	58.50	44.50	26.00	20.40	42.90
1849	10.70	14.50	30.00	40.50	53.70	58.90	69.60	54.75	56.40	40.90	30.40	19.50	39.99
1850	10.00	14.07	25.50	35.00	55.00	69.50	67.60	64.00	58.30	50.00	29.73	21.00	41.64
1851	20.50	14.22	31.75	39.16	57.00	62.50	64.25	70.00	51.50	40.00	25.80	19.00	41.31
1852	20.50	19.28	21.00	32.00	50.50	64.50	69.00	65.50	58.00	43.00	30.00	21.00	41.19
1853	22.00	12.70	23.50	38.00	54.00	63.50	69.75	67.00	56.50	43.50	28.70	23.75	41.91
1854	10.50	9.00	22.34	34.16	52.30	67.10	70.40	64.50	57.25	45.75	32.30	15.25	40.07
1855	21.70	14.30	29.20	39.60	40.80	63.70	67.20	68.25	60.00	43.75	30.00	21.00	41.63
1856	22.00	18.50	20.40	35.50	51.30	67.40	68.50	64.00	57.70	44.00	28.90	20.00	41.51
1857	14.20	20.00	24.50	32.70	50.60	65.30	60.80	62.30	52.00	42.50	31 00	19.50	39.62
1853	8.30	23.10	24.70	34.60	50.00	59.15	65.30	62.40	53.00	42.50	33.40	21.50	39.83
1859	17.75	19.00	25.50	33.00	51.50	63.00	64.50	67.00	57.00	39.50	34.00	14.00	40.48
1860	18.20	16.00	28.50	38.00	58.50	66.50	69.00	66.00	55.50	49.00	39.00	19.00	43.60
1861	19.50	22.00	27.00	41.50	48.50	63.25	68.00	66.00	54.00	45.00	32.00	21.00	42.31
1862	16.00	19.50	26.50	39.00	55.00	63.00	68.00	62.00	59.50	48.00	30.00	20.00	42.21
1863	24.00	19.00	19.20	36.10	59.20	64.30	70.20	70.00	56.00	47.00	26.70	18.40	42.51
1864	18.00	20.60	31.00	41.00	55.00	68.20	71.90	70.90	55.88	48.10	33.86	22.56	44.75
1865	14.80	19.06	33.80	40.97	49.21	67.30	60.84	70.82	56.55	37.42	34.56	24.46	42.48
1866	14.45	20.35	27.50	37.98	45.10	69.00	73.25	60.90	52.37	48.68	45.72	20.91	43.02
1867	9.62	23.52	24.61	39.10	49.34	65.97	70.06	64.83	49.37	44.93	30.05	10.90	40 19
1868	11.69	8.87	28.45	34.61	53.04	63.65	72.07	67.26	54.98	41.49	29.55	14.86	40.04
1869	19.27	20.00	19.67	38.80	51.91	61.78	68.19	63.83	62.07	43.30	30.53	22.03	41.78
1870	22.08	16.31	23.89	43.31	54.08	69.12	72.57	67.63	60.42	46.69	33.71	22.15	44.38
1871	13.74	17.42	34.45	42.00	53.99	64.92	68.18	66.86	55.21	47.75	26.69	17.27	42.37
1872	14.62	16.31	16.72	38.74	54.88	66.95	70.43	69,66	59.77	45.48	31.80	9.09	41.20
1873	12.69	15.20	24.31	38.69	51.85	62.17	69.66	65.48	57.00	47.10	23.37	19.97	40.62
1874	20.26	17.40	24.84	31.08	51.50	64.17	70.45	63.75	58.61	46.42	27.68	15.26	40.95
1875	5.96	9.79	21.77	33.47	52.06	61.43	64.96	66.73	51.96	41.22	24.05	18.44	37.66
1876	19.39	16.17	25.95	37.04	50.18	65.57	68.15	65.48	55.22	40.28	34.33	12.00	40.69
1877	9.78	24.10	27.70	42.40	52.48	63.99	68.96	66.84	58.71	43.83	36.86	24.36	43.38
1878	15.02	20.83	32.41	46.70	52.10	61.88	68.46	65.70	58.82	48.72	32.20	21.19	43.67
1879	13.08	13.00	25.84	35.80	54.73	60.82	66.43	60.92	54.05	50.27	31.61	21.79	40.69
1880	24.41	21.74	24.10	40.10	57.85	62.67	65.53	64.51	59.08	43.28	27.85	15.88	42.25
1881	9.03	18.25	32.64	37.77	56.79	57.50	65.72	66.32	62.90	44.16	32.00	28.45	42.62
1882	13.27	20.05	25.33	34.16	46.78	61.93	66.52	65.62	57.30	48.11	30.54	18.64	40.69
1883	9.87	15.00	16.83	36.90	52.07	65.56	66.12	63.41	55.95	41.51	34.33	17.43	39.66
1884	9.09	21.80	24.85	39.23	51.49	65.49	64.61	64.76	58.38	43.59	30.55	21.65	41.29
1885	15.39	8.75	15.63	41.07	62.99	61.70	66.16	61.41	53.27	45.73	35.63	22.97	40.89
1886	15.39	25.24	44.08	55.26	59.87	59.87	66.32	64.52					
Mean to 1886	15.54	17.28	25.82	37.89	52.50	64.21	67.94	65.43	56.55	44.66	31.46	19.36	41.55

This shows that the last thirteen years indicate an average decrease of nearly one degree from the twenty-five previous years, and reduce the mean one-fourth of one degree for the entire period. During this time there has been a very large amount of timber removed from a radius of forty miles, probably more than from any other section of New England where observations have been kept.

For the reasons already given you will doubtless admit that all waste places, and those where the crops do not pay a profit, should be returned to forest. To do this it is necessary to keep cattle out, as they will, more or less, injure every sapling in the pastures, and, when injured, they never make perfect trees. In my experiments in tree-growing I find that a healthful tree of almost any kind will make a diameter of sixteen or seventeen inches in twenty-five years, and many yield a handsome profit in that time; hence

TREE CULTURE FOR PROFIT

may be as good an investment as we can make. If a Vermont man wishes to invest either in the state or outside of it, nothing is more sure of giving a substantial profit. Let us see what D. C. Burson of Kansas, says in an address at the Forestry Congress at St. Paul:

"More able tongues have talked; more gifted minds have thought; more ready pens have written upon the great future necessities of forest tree planting. But all the talking, thinking and writing, have so far availed comparatively little. Why is it? Because too many look upon it as an act of benevolence, thinking they must metamorphose themselves into philanthropists before they can set out a grove of forest trees, while a few, perchance, will set it out with a feeling of pride, while others may do it for honor or fame. But is benevolence, philanthropy, pride, honor or fame, the motive power that impels the progressive car in this, the nineteenth century? No! It is money—the love of money, or the anticipation of money. Then let us consider tree planting in its true light; a light that will illumine the mind of every American citizen,—the light of money making."

"Yes! if we do that we strike the keynote, whose music will vibrate throughout the length and breadth of our Western plains. Our capitalists, East, West, North or South, all invest their money for the purpose of increase; their sole object is to accumulate. Our merchants do not invest their money in dry goods and groceries, and work and worry over their business for the sole purpose of accommodating their friends and neighbors with the necessaries of life. The capitalist does not invest in bank or railroad stock with the spirit or feeling of a philanthropist. Vanderbilt, Garrett or Gould, does not extend railroads over our plains or along our valleys for the purpose of assisting the poor granger to get his few bushels of corn or wheat to market. The millionaire who has his palatial mansion and is enjoying all the comforts of life, does not invest his surplus capital in corner lots, fine dwellings or massive blocks, for the purpose of beautifying the city or giving his poor neighbor a home. We do not invest in electric lights or telephone stocks to make the blind see or the deaf hear. But in each and every one of these investments the one great object is to make money. Then if this is the motive power in everything that is progressive, it is folly to look at tree planting in any other light. And in that light alone, yes, in that electrifying light, we shall for a few minutes consider tree planting. For we think without being in the least egotistical, we have the power to show that forest tree planting will make a safer investment and bring in larger and more satisfactory returns than any other business that man can embark in. But in this enterprise you cannot sow and reap the same year; you sow in your prime and reap in your decline, and to the benefit of your children who follow after. And to illustrate this point and to show it in the most practical light, we will take a kind and thoughtful parent, who has a bright and promising son of five summers, in whom he takes a great interest, and wishes to see comfortably started in business when he attains the age of twenty-one. Having $5,000 which he wishes him to have at that time—sixteen years hence—and wishing it to increase as fast as possible, he very naturally asks himself, "How shall I invest it so that it will not only be safe, but increase in the greatest ratio?" Government bonds are safe; but then the interest is so very small that his capital would only increase about $3,000 in the sixteen years, even at compound interest."

"He next investigates a real estate mortgage bearing six per cent interest. In this he finds his capital would only be about $10,000 when he wants to use it, but the father being desirous of a large increase, looks beyond bonds and mortgages, and beholds the treeless plains of the great West, which is fast settling up by the industrious emigrant; he sees that building material, especially fence posts and railroad ties are in great demand, and that demand is fast increasing, while the material is decreasing in an equal if not a greater ratio. He beholds a glorious future for the tree planter, his mind is now fully made up; he will invest his $5,000 in Western lands and forest trees. He selects forty acres of good tillable land, for which he pays $800, and encloses it with a good substantial fence, for which he pays $200 more, leaving $4,000 of the capital yet uninvested. He now puts the entire forty acres under a good state of cultivation, preparatory to setting out in forest trees. He is somewhat at a loss to know what species of trees to plant. but he decides that it must either be Catalpa, White Ash, Russian Mulberry or Black Walnut, but as his land is situated south of 44° north latitude, and fence posts and railroad ties being in the greatest demand and the most profitable of any wood he can raise, and the Catalpa having no superior for that purpose, (the timber lasting a century), and being a hardy tree and a fast grower, he decides that that shall be the tree. By adopting the usual plan of setting four by four feet each way, it will require 2,700 trees per acre, or 108,000 to set the forty acres. He finds that to prepare the ground, buy or raise the trees, set them out and cultivate as long as they require any attention, it will cost about $100 per acre, or the remaining $4,000. He has now the entire capital invested."

"Let us look for the returns. The weeds and grass being kept down, he will let nature take its course, do her own trimming and pruning until they are eight years old. Of course the results are only imaginary, based upon the knowledge and experience of others, but we propose to be very liberal in our estimates. We will in the first place calculate on a loss of 25 per cent, that is we will suppose that by the extreme changes of climate 28,000 have either died or been so stunted as to be worthless, which leave just 80,000 good thrifty trees eight years old. It now becomes necessary to remove one-half of them, or 40,000, each tree making at least one good fence post. A Catalpa post, even an inferior one, will always bring a good price, say twenty-five to thirty-five cents, but we will put them down at twenty cents each; calculating that the remaining timber of the trees being utilized for fire-wood, will pay for cutting and removing the posts. We now have 40,000 posts at twenty cents each, making a total of $8,000. The remainder of the trees are left standing eight years longer, or until the son attains his majority and is ready to start in business. The father puts the axe-men at work to remove them and convert them into ready cash. We of course have again to let imagination, experience and precedent do the calculations. We cannot take isolated cases and make comparison or we will estimate too largely, for we have heard of Catalpas sixteen years old, being twelve to fourteen inches in diameter, which would make two or three railroad ties, or ten or twelve fence posts, but as we would sooner be below than above, we will say that there can be realized on an average four good posts per tree, or 160,000 posts, which at twenty cents each would amount to $32,000; added to what we have from the first thinning we have a grand total of $40,000, or over 40 per cent per annum for the entire time."

"Now I know that these results look incredulous, especially to a person who has never given the subject any thought; but the experience of many will bear me witness in these statements, and claim that even greater results can be attained, while others who have been reared in the woods, cradled in a sugar-trough, and, perchance, housed in a hollow tree, and spent the prime of their lives in cutting and burning valuable timber with no conception of its value, may say that twenty cents for a fence post is an enormous price, and the average farmer cannot afford to buy them. Well, for the benefit of that class let us make a large reduction, and put a Catalpa post that will last a hundred years at the same price of a Cottonwood that will not last two years—ten cents each—and yet we have $20,000, or about 20 per cent per annum, two or three times as much as could be realized in bonds or mortgages. But it is unnecessary to make any reduction. Ten millions of Catalpa fence posts could be sold in Kansas today at twenty-five cents each, and as many railroad ties at double the price of an oak."

"In making the above calculations we have said nothing about the land after the timber had been removed, neither have we said anything about taxes, so we will allow one to offset the other. We have also confined ourselves to dollars and cents, and said nothing about the pleasure and comfort derived from shade and wind-breaks. But the mission of this article is not to picture the beauties and pleasures of forest groves, or to calculate the untold value to fruit orchard, grain field or pasture lots, but it is to show just how many dollars and cents can be realized in a certain number of years by raising timber for commercial purposes."

It might be considered that in our state the realization of profit would be uncertain. But let us see. I have White Pine trees on my experimental farm, twenty-five years old and 17 inches in diameter. They should be set 1,261 to the acre, and they should average fifty feet in length that could be used for timber in that time, or one tree should produce 200 feet of inch boards, worth four dollars. 1,000 trees would be worth $4,000, less cost of culture and cutting. But this is an extreme case, you will say, and so it is. Yet my trees were planted four feet apart, which would be 2,560 to the acre, and they can be grown that near together, but half the number ought do well, and that number should each be eighteen inches at stump, and six inches fifty feet from ground in twenty-five years of good culture. They would then be worth in boards as I have stated, but much more in staves or other small ware products. But let us consider. The land was worth little to begin with, the culture has not cost very much, as any farmer can raise a score of acres where he has good pine land, and if one-half or even one-fourth the sum were realized, what would pay better as an investment? Elm, I find in my experiments, will grow as large but not as high. Fir will reach three-fourths the size, and Butternut the same: hence the actual profit of tree culture is greater than any other product of the farm. But with judicious thinning it can be made even more productive. The larger the tree the greater the capability of increase.

The timber of our country, with scarcely an exception, grows by the addition of a ring of new wood annually next to the bark. If we suppose these rings of growth to be true circles and of equal width, their radii would be from year to year as follows:

1, 2, 3, 4, 5, 6, etc.—an arithmetical series.

The areas within these rings would be to each other as the squares of these radii, viz:

1, 4, 9, 16, 25, 36, etc.—a geometrical series.

The differences between these successive numbers would show the relative areas of the rings, or (if, for a given length, they could be separated and weighed), their value, and the numbers would be:

1, 3, 5, 7, 9, 11, etc.—an arithmetical series,

of which the common difference is two. In other words, a tree will grow three times as much in weight and value during the fifth year as it did in the second; three times as much in the eighth year as in the third, and so on, besides its increase in height. Furthermore, a large tree is more valuable than a small one, in proportion to its weight or solid contents, because it can be applied to more uses.

From this it may be seen that with judicious cutting of one-half the timber at twenty-five years the other half will have many times doubled its value the next twenty-five years; so that almost fabulous interest may be gained. The profits from fruit culture are also enormous, and require less amount of labor than most other products of the farm. It is well for all to consider the profits from forestry. It has proved remunerative in Europe, where it has been under government patronage and protection for 150 years. There is no guesswork about the results there. The book-keeping is thorough and the balance-sheet reliable. Prussia, from her 6,000,000 acres of state forests, receives an annual net income of about $7,000,000. Saxony, from her 400,000 acres of forest lands, receives an annual net income of about $1,350,000. Bavaria, from her 3,000,000 acres, receives annually, after paying all expenses, a net profit of $4,500,000, and their forests are rapidly improving; yet this means a net profit after paying for all labor or improvements.

TIMBER IN WASTE PLACES.

Viewed as an agricultural product, timber offers this distinguishing feature: it will grow in places where nothing else can be cultivated. A soil too coarse and meager for the cereals may be marvelously productive in forest growth. Ravines and slopes too steep for any other useful product are the favorite seats of timber, and wherever a crevice is found in a rocky ledge the roots of a tree will burrow and spread, taking a hold so firm as to defy the storm, and acting mechanically and chemically to disintegrate the rock and change its constituent elements into useful products.

The roadside, the river bank, along the brook, and on the overhanging cliff, a tree may always be earning wealth to its owner, in our densest settlements, and in the waste places of our most valuable lands. In many of the states laws have been enacted favoring the planting of trees along the highways, and a laudable emulation should be everywhere encouraged in the ornamentation of farms in this way. It is worthy of the consideration of our state legislature as to whether these plantings may not be made a requirement; or be done at the cost of the owners, if they neglect it.

THE ADAPTATION OF TREES TO DIFFERENT SITUATIONS.*

When land is about to be put under wood, it is necessary to determine on the species for which the soil and climate are adapted. In respect to the soil, its qualities can only be ascertained accurately by a knowledge of its chemical and mechanical composition; but, guided by experience, intelligent, practical men are often enabled to arrive at a tolerably sound judgment by simple inspection. The importance, however, of a comprehensive knowledge of the chemical qualities of soils will be understood, when it is considered that the inorganic or mineral ingredients of wood vary with the species; and if the substances required by any particular kind of tree are not present in the soil, it is obvious that that species cannot be grown in perfection. A selection of the crop that will suit the soil is just as necessary in growing timber as in rearing agricultural produce; and when an error is committed in the one case, the loss which is sustained in consequence is immensely greater than when a similar mistake occurs in the other. Nor can rotation be altogether neglected in the rearing of wood. The same species should rarely be grown twice in succession. Scarcely any kind of land can produce two heavy crops of fir, one after the other. Cases, no doubt, are known in which larches have been planted on land newly cleared of heavy fir; but they have seldom made much progress for at least a number of years. And except with fir after fir, and larch after larch, the test is not a completely accurate one. Hard wood, oak, ash and elm, grows luxuriantly after hard wood only on land which is rich in the mineral matters that are capable of fully developing it. Very seldom will hard wood succeed after firs; but firs grow well after hard wood in almost any instance. The necessity, not only for adapting the species of wood to be grown to the nature of the soil, but for observing some sort of rotation in the raising of different kinds of trees, will be seen by a reference to the following table of inorganic analyses, compiled from various reliable sources:

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*From Morton's Resources of Estates, p. 292—295.

Forest trees.	Potash.	Soda.	Magnesia.	Lime.	Phosphoric acid.	Sulphuric acid.	Silica.	Peroxide of iron.	Chloride of sodium.	Chloride of potassium.	Analyst.
Oak wood	5.65	3.77	3.01	50,58	2.32	0.78	0.52	0.38	0.02	......	Dennigen.
Oak bark*.............	3.50		0.80	47.50	......	0.30	1.10	......	0.03	......	Berthier.
Oak leaves............	27.40		3.60	16.70	10.90	......	14.50	1.80	......	......	De Saussure.
Elm wood............	21.92	13.72	7.71	47.80	3.33	1.28	3.07	1.17	......	......	Wrightson.
Elm bark	2.22	10.09	3.19	72.70	1.59	0.62	8.77	0,82	......	......	Do.
Beech wood...........	11.80	2.04	8.42	47.25	3.29	1.01	1.09	0.60	0.16	......	Liebig
Beech bark	2.	00	17.10	37.50	2.70	......	9.20	0.30	......	......	Hertwig.....
Horse-chestnut wood.	10.10		3.20	43·60	1.50	1.20	7.50	3.00	0.07	......	Berthier.
Birch wood.	12.70		2.50	43.80	3.60	0.40	4 80	0.40	0.03	......	Do.
Poplar wood..........	32.60		3.30	18.30	10.10	......	3.30	1.50	......	......	DeSaussure.
Poplar bark...........	18.80		1.00	35.10	3.20	......	4.00	1.50	......	......	Do.
Poplar leaves.........	28.50		1.40	21.40	4.20	......	11.50	1.50	......	......	Do.
Scotch fir wood†	2·79	15.99	19·76	31.74	1.93	3.04	3.04	3.51	1.48	1.48	Bottinger.
Scotch fir bark........	1.90		2.40	38.60	7.10	......	17.30	0.60	......	......	Hertwig.
Scotch fir leaves	10.50		3.10	36.80	4.70	0.90	11.60	0.50	......	......	Do.
Larch wood‡..........	15 24	7.27	24.50	26.97	1.79	3.60	3.60	4.25	0.92	0.92	Bottinger.

*Oxide of manganese in ash of oak bark, 7.20 per cent.
†Oxide of manganese in ash of fir wood, 18.17 per cent.
‡Oxide of manganese in ash of larch wood, 13.15 per cent.

From this table it is obvious that all soils cannot be alike suitable for every kind of timber; elm and larch, for instance, contain a much larger proportion of potash than others, and hence would require a fine soil well fertilized with potash. Again, the poplar contains a large amount of both potash and phosphoric acid, showing that it will only grow luxuriantly on our best soil.

CULTURE AND MANAGEMENT OF OUR NATIVE FORESTS.

Cleaveland, in his work on forest management, says man's progress from barbarism to civilization is indicated by the degree of skill he has attained in the cultivation of those products of the earth which minister to his necessities and comfort. As long as the natural resources are sufficient to supply his primary wants of food and clothing, he will make no effort to increase them, and it is only as he is driven by the necessities of increasing demand and diminishing supply that he exerts himself to secure relief by artificial means.

Nature, therefore, as if she had been conscious that forest culture was too arduous an undertaking for primitive man, has furnished so abundant a supply that no deficiency or necessity of economy is felt till the nation has acquired such a degree of intelligence as to be competent for the solution of the problem.

Where shall we find, or how shall we create, the men who are competent to do the work? To judge from experience, our people appear not only to be ignorant of the first principles of forest culture, but unconscious even of the possibility of its application to the development of our native woods. The fact of such prevailing ignorance rests not alone upon negative evidence. We have positive proof in abundance in the attempts which we often see at the "improvement" of a piece of woodland when it is appropriated as the site of a residence. It is hard to conceive of anything more dismal or forlorn than the average result of the effort to impart a homelike aspect to such a place; the dwelling, with its "span new" expression, standing in the midst of a multitude of tall poles, with tufts of leaves upon their tops, looking like fowls stripped of their feathers, and the bare ground fretted everywhere with freshly upturned roots, the sole remnants of the wild shrubbery which has been ruthlessly exterminated.

In order to comprehend the principles of healthy forest growth, let us consider some of the processes of nature, and learn from them her requirements.

If we plant the seed of a maple, linden, oak or ash tree by itself in the open ground in suitable soil, and suffer it to grow without molestation, simply guarding it from injury, we shall find that the first act of the young plant is to send out broad leaves, which serve among other purposes to shade completely the stem, and the ground immediately around it in which the roots are growing. As the tree grows, it maintains a symmetrical shape, the limbs spreading and the trunk increasing in size, in proportion to its height, but always preserving the condition of keeping the trunk and the ground for a considerable distance around it in the shadow of the foliage till mature age, when the roots have penetrated to such a depth as to be safe from injury, and the trunk is protected by thick layers of cork-like bark, which safely guards alike from heat and cold inner layers and young wood in which the sap is performing its functions.

Such are the conditions to which nature adheres, if not interfered with by accident or design, and such, therefore, we may be sure are those best adapted to healthy and vigorous growth. The fact that they are continually violated with apparent impunity serves only to show the wonderful power of nature to supply deficiencies and adapt herself to circumstances, but in artificial culture we should aim as nearly as possible to imitate the course she would pursue if unimpeded.

The requirements of nature are of course the same when trees are growing together in a forest as when they stand singly, but the conditions of growth are so changed that the end is attained by entirely different means.

If we enter a tract of woodland, covered with a hard wood growth of an average height of thirty or forty feet, we find it composed almost exclusively of trees which have run up to a great height in proportion to the spread of their limbs. The largest and oldest of them may have had some lateral branches which are now dead, but the younger growth will consist only of tall, slender stems, without a branch or leaf except near the top. It will be difficult, perhaps impossible, to find a single tree possessing sufficient symmetry of form to be worth transplanting for ornamental use. A little reflection will serve to convince us that this form of growth, so different from that of the single tree in the open ground, is the natural result of the action of the same rules under changed conditions.

When a young wood first springs up on open ground, each tree begins to grow as if it were alone, sending out lateral branches, and preserving its just proportion. But whenever these laterals meet and mingle with each other they shut out the sunlight from all below, and thenceforward all lateral growth must cease, and each individual is struggling upward to keep even with its neighbors, and secure its share of the sunbeams which are essential to its existence, and which can only be had at the top. It thus becomes forced out of all just proportions in the effort to keep even with its fellows. The conditions of keeping the trunk and roots in the shade, however, are even more rigidly adhered to than in the case of the single tree, growing by itself, for the whole area of the wood is shaded, and, moreover, the trees on the edges of the wood, if not interfered with by men or cattle, will be clothed on the outer side with limbs and foliage clear to the ground, so as to check the free passage of the winds whose drying influence upon the soil is even more active than that of the sun.

If we examine more closely we shall find that nature adapts herself to these changed conditions, and avails herself of whatever advantages they afford.

The single tree when growing by itself sends its roots deep into the ground in search of the moisture which cannot be had near the surface, and thus, when it reaches mature age, it draws its supplies from sources beyond the reach of temporary changes, and, moreover, secures so firm a hold upon the ground that it suffers no injury from the storms that assail it, but fearlessly stretches forth its arms as if to challenge the gale.

In the woods, on the contrary, the surface soil never becomes parched or heated, but maintains an even degree of temperature and moisture in consequence not only of the exclusion of the sun and winds, but of the deep mulching of leaves which annually cover the ground and keep it moist, while, by their decomposition, they form a rich mould comprising all the ingredients of vegetation.

If we dig only a few inches into this mould we find it everywhere permeated by fibrous rootlets emanating from larger roots, which, under these circumstances, have kept near the surface, where they draw nourishment from the rich material there provided. If the single tree in the open ground had tried to live by such means, it would speedily have perished for want of nourishment, or would have been uprooted by the winds as forest trees are liable to be when left alone in a clearing.

In the woods the necessity no longer exists of sending the roots to a great depth either in search of nourishment or for support against storms, and nature always adapts herself to circumstances and attains her ends by the simplest and most economical means.

If we now consider the facts I have stated, which any one can easity verify for himself, we shall find that all the essential principles of tree culture are comprised within their limits, and by their rational observances we may secure healthy and vigorous trees, and develop at will such forms as will fit them either for timber or for ornamental use.

The four trees I have cited—maple, linden, oak and ash—are among the most common and yet the most valuable of our forest trees, and may be taken as representatives and proper illustrations of the facts I am stating. Either of these trees, if growing by itself in proper soil and undisturbed by other than natural influences, will attain at maturity a height of seventy or eighty feet, with a spread of limb equal in diameter to its height, and a trunk of such massive proportions as leaves no room for apprehension of inability to uphold the wilderness of foliage it has to support. But this same tree, if growing in a wood, will send up a slender stem, straight as an arrow, fifty, sixty or seventy feet without a limb or a leaf, till it reaches the average height of its fellows, and sends out its tufts of foliage to secure the benefit of every sunbeam it can catch.

We see, therefore, that if we wish to form a beautiful and symmetrical tree, or a grove of such, composed of individual specimens of majestic and graceful proportions, we must allow it free access to sun and air, with full power of expansion on every side. While young, however, the growth will be more vigorous and healthy, and we can develop the desired forms more easily and successfully by leaving a much greater number of trees than are eventually to remain, and removing from year to year all which are near enough to the final occupants to check or impede their full development.

If, on the other hand, we wish to develop the trunk for use as timber we must plant, or allow the trees to grow more thickly together, and thus extend their trunks longitudinally by forcing them to ascend in search of the sunlight on which their very existence is dependent. The indigenous growth, however, is always a great deal too thick for successful development. The trees are so crowded that many of them perish in the struggle, and those which survive are drawn up into such spindling proportions that not one in a hundred ever attains the dignity of timber, whereas by proper and reasonable thinning, and judicious culture and pruning of the trees selected for final retention, every acre of woodland may be made to yield an annual crop of fire-wood, and all the while be growing timber which eventually in many instances may be worth more than the land itself; or by a different process of management may be converted into a grove of majestic and graceful, ornamental trees.

The proper performance of this work constitutes the most important part of forest culture, and for want of the knowledge of how it should be done, or from ignorance of the possibility of its application to our native forest, a vast area (in the aggregate) of woodland is running to waste, yielding no revenue and promising nothing better in the future than fire-wood, and yet a very large proportion is susceptible of redemption and conversion into timber of great value at far less cost of time and labor than would be required for the planting and rearing of new forests, while the very development will be yielding an annual income instead of demanding a large outlay.

Travel where we may we are never out of sight of forest, and every wood lot is a mine of wealth waiting only the application of intelligent labor for its development. In almost every tract of woodland may be found more or less of the trees I have named, and in many places also butternut, elm, cherry, beech, and other valuable timber trees, mingled with a great variety of those which are worthless or fit only for fuel. In some cases they are past redemption, having been so long neglected that they have run up into mere thickets of hoop-poles. Young growth may everywhere be found, however, which is in condition to be taken in hand, and in almost all cases the work of thinning and pruning may be entered upon with a certainty of profitable results if wisely and perseveringly conducted.

The work of thinning, as ordinarily conducted in the occasional instances in which, on any account, it has become desirable, is usually entrusted to mere laborers, who have no regard for the natural conditions which are essential to healthy growth, and which cannot be suddenly changed without serious injury to the trees that are left.

All the small growth of shrubs, such as hazel, dogwood, elder, shad-bush, etc., is first grubbed out and destroyed under the general term of " underbrush," and this is done not only throughout the interior of the wood, but around its outer edges where such shrubbery is apt to spring up in thickets which serve the very important purpose of preventing the free passage of the wind over the surface soil of the interior, besides adding incalculably to the beauty of the wood, as seen from without, by connecting the line of foliage of the trees with that of the sward below, and thus presenting a living mass of verdure. The trees which are considered most desirable to preserve are then selected, and all the rest at once removed. Finally the leaves are carefully raked from the surface and carried off or burnt.

Sun and wind now have free access to the soil, and it very soon becomes parched and dry. The fine rootlets near the surface, which have heretofore been preserved by the never-failing moisture of the rich mould under its mulching of leaves, are converted into a mass of wiry fibres, no longer capable of conveying nourishment, even if it were within their reach. And while the means of supply are thus reduced, the tall, slender trunk, through which the sap must ascend to the leaves, is now exposed to the free action of the sun and winds. Now I do not presume to say that evaporation can take place through the bark, but the provisions which nature makes to guard the inner vital tissues from the effect of the sun's rays indicate beyond all question that they are in some way injurious. I have elsewhere shown that in the case of the single tree growing by itself the trunk is always shaded by the spreading foliage, when suffered to retain its natural form. In the forest the trees shade each other, and thus effect the object by mutual action. But now let me call your attention to another provision of nature which few people observe, but the meaning of which is too obvious to be mistaken. If we examine the bark of an oak, elm, chestnut or maple, of mature age, which has always stood by itself, exposed to the full influence of atmospheric changes, we find it to be of great thickness, of very rugged character, and of a cork-like consistency, all of which characteristics make it the best possible non-conductor of heat or cold that can be imagined, under the protection of which the living tissues are safely kept from injury through the burning heat of summer and the intense cold of winter.

Now go into the forest where the trees shade each other, and wind and sun are excluded, and you will find that the bark of the trees is smooth and thin in comparison with that of those in the open ground.

Nature never wastes her energies needlessly, and the trees in the woods do not require the thick coat of those that are exposed. But the effect of suddenly admitting the sun and wind upon them is precisely the same as that of exposing any portion of the human skin which had heretofore been clothed. It is to guard against injury from this source that experienced tree-planters, when removing large trees from the woods, are accustomed to swathe the trunks with ropes of straw, which is a rational process, yet it is by no means uncommon to see the reverse of this action. Sometimes trees may be seen from the trunks and large limbs of which all the rough bark has been carefully scraped, leaving only a thin, smooth covering over the inner tissues. This is as if a man should prepare for unusual exposure to heat or cold by laying aside all his clothing.

Few persons, even among those whose business is tree culture, as fruit growers and nurserymen, have any just conception of the value of thorough mulching as a means of promoting the health and vigor of growing trees. In fact, such a mulching of the whole ground as nature provides in the forest by the annual fall of the leaves may be said to be unknown in artificial culture, so rarely is it practiced, yet its immediate effect in promoting new and vigorous growth is such as would seem almost incredible to one who had not witnessed it, and affords one of the most beautiful illustrations of nature's methods of securing the most important results by such simple means that they escape our notice, though going on right under our eyes from year to year.

Of course the richest food for plant consumption is in the soil near the surface, but if that soil is subjected to alternations of temperature and moisture, sometimes baked in clods, and at others reduced to the consistency of mire, no roots can survive the changes. In the forest, as I have elsewhere said, these changes are prevented by the shade of the foliage and the mulching of fallen leaves. The rich mould of the surface soil maintains an even temperature, is always moist, and is everywhere permeated with fibrous roots drawing nourishment from the rich sources which surround them, and this process may be artificially imitated, and the same results attained, by mulching, if properly done. It does not suffice to pile a few inches of straw or manure around each tree for a short distance from the trunk. If the tree stands singly, at a distance from others, the mulching should extend on every side beyond the spread of its branches; and in the case of an orchard, or young wood, the surface of the whole area it occupies should be covered with leaves, straw, shavings, chip-dirt, tan-bark, or whatever material is most available, to a depth of several inches.

No fruit grower who has once tried this experiment will ever after forego the advantages it offers, and I have spoken of it thus at length from the obviously vital importance of its bearing on forest culture. A moment's reflection will show that in the opening and thinning of native wood which had grown thickly together, a heavy mulching of such portions of the ground as may unavoidably become exposed may be of most essential service in preserving the health and vigor of the trees that are to be retained.

It is difficult to lay down specific rules by which a novice can be guided in the work of opening and thinning out the wood of a native forest, other than by fully impressing him with the importance of preserving, so far as is possible, the conditions which nature shows to be the most favorable to vigorous growth, and proceeding very cautiously when it becomes necessary to change the relative proportions of the influences which affect the vitality of the trees. The age and condition of the wood at the time the work is begun are, of course, important elements for consideration. If the growth is not more than ten or fifteen years, and the trees have not sprung up so thickly as already to have become a mere thicket of hoop poles, but have preserved a reasonable degree of symmetry, its management can be much more easily controlled than if it has attained a more mature age, and especially if the object is to create an ornamental grove composed of fine specimens of individual trees, a process by which the value of desirable residence sites in the vicinity of cities or large towns may often be very greatly increased.

Whether this be the object or the development of timber, the first thing to be done is to select and place a distinguishing mark upon every tree which is ultimately to be retained. Then remove at first from its immediate vicinity only those which are actually crowding it, or impeding its growth by shading or interfering with its foliage. Those which simply shade the trunk or the ground around it are serving a useful purpose and should not be disturbed. Indeed, if it is found that the necessary removals involve much increased exposure of the surface soil around the tree, the soil should at once be covered with a mulching of sufficient depth to prevent the possibility of its becoming heated and dry. All other sources of danger to the health of the trees are insignificant in comparison with that of the rude check they are liable to receive from sudden exposure of the trunks and surface roots to the influence of the sun and wind, from which they have heretofore been protected, and to which they can only become accustomed by a gradual change.

The next year it will be found that the tree has gladly availed itself of the opportunity for expansion, and has spread its limbs to fill the vacant space around it, so that more trees must now be removed, while the increased mass of foliage it has developed renders it less liable to suffer injury from their loss.

The removal of the undergrowth of shrubbery should be very cautiously conducted, and in no case should it be removed from the outskirts of the wood, which should everywhere be left with as dense a growth as possible, to prevent the entrance of the winds.

The sirocco-like wind from the South-west, which often blows with great violence for days together, especially in the spring and early summer, when the trees are full of sap, and the young shoots and leaves are tender and sensitive, is the one from which most danger is to be apprehended. The merely mechanical injury it inflicts upon the spray and foliage is often serious, but its worst effects are due to its absorption of moisture and vitality.

The work of pruning the trees which are to be preserved for timber involves a careful consideration of the principles I have set forth, apart from the judgment required for the skilful performance of the mere manual labor. The object in view being the development of the trunk, it is important to remove any limbs which threaten to become its rivals in size, if any such have become established before the work of improvement began. But after the trunk has attained the desired height, it is on all accounts desirable to develop the largest possible mass of foliage, because the making of wood can only be effected by the elaboration of the sap, which is the work of the leaves.

If one is rearing a new forest, in which the trees have been under his control from the time of planting, it must be the result of his own ignorance or negligence if he has failed to secure such forms as he desired, since it is easy to direct the growth of young trees, and prevent them from running into extravagances which will unfit them for service as timber. And not unfrequently we may find a young wood of indigenous growth, which may be taken in hand and wrought into such shape that its future progress can be easily directed. But, for the most part, in woods that have been suffered to run wild till they have approached maturity, a good deal of skilful pruning will be required to bring the individual trees that are to be preserved into such form as will give them most value. Nothing but practice and careful observation can confer this power. The little treatise of DesCars on the pruning of forest and ornamental trees, translated by Mr. C. S. Sargent of the *Arnold Arboretum*, and published by A. Williams & Co. of Boston, (price 75 cents) contains full and explicit illustrated directions for all the manual work of pruning, and is invaluable as a guide to the novice, and a work of reference to experienced foresters. But mere manual skill in the performance of the work will be of little avail without the application of a thorough knowledge of the principles of tree growth, and a strict compliance with the requirements of their nature.

If our agriculturists will but apply to the management of their forests the same intelligence with which they direct the culture of other farm crops, they will find an equally ready response to their efforts. The farmer who should leave his field of corn or potatoes to shift for itself, or suffer his cattle and hogs to ramble through it at will, would be justly sneered at by his neighbors and punished by the loss of his crop, and trees have no more capacity for self-management than corn or other vegetables, and are quite as ready to profit by judicious culture, and to yield returns corresponding to the care bestowed upon them. They are not liable to be utterly destroyed as corn is by the incursions of live stock, but they do suffer serious injury from the trampling and rooting up of the ground.

If every owner of a wood lot could be convinced that its value might be enormously increased by a process which, so far from demanding an outlay, would add to his annual income, it would not be long before farmers would consider it as derogatory to their reputation to leave the forests in the wild condition they now are as they would to have a field of corn presenting a similar appearance of slovenliness. To produce such conviction the truth must be demonstrated in actual practice, and the cost of such demonstration will be but a trifling price to pay for the returns it will bring. The process would soon begin to be imitated, a conviction of the value and importance of a knowledge of forestry would become established in the popular mind, and the demand for the services of those who had acquired it would lead to a demand for the means of acquirement, and thus the schools of forestry would be called into existence by the natural course of events.

DEMANDS AND PRICE OF TIMBER.

The demand as well as its price is constantly increasing. The large and rapidly increasing demands made upon our forests in the supply of railroad ties alone are impressively shown by Prof. Egleston in his report on forestry issued last year, to which I am indebted for the facts following: There are now in use in this country about 150,000 miles of railroads, which have required 396,000,000 ties, or the wood supplied by 3,390,000 acres, an area larger than that of the States of Rhode Island and Connecticut. Estimating that ties need to be renewed on an average once in seven years, there must be drawn from the forest annually 56,571,428 ties, requiring the timber on 565,714 acres. Allowing thirty years as the time necessary to produce trees of proper dimensions for ties, it will require 16,971,420 acres of wood land to be kept constantly growing as a kind of railroad reserve in order to supply the annual needs of the existing roads. This constitutes an area larger than the States of New Hampshire, Vermont, and Massachusetts combined, or the States of New Jersey, Maryland, and Deleware, with the addition of Connecticut. It is more than four per cent of the total area of wood land in the United States, exclusive of the Territories, and three per cent of the area in the States and territories together. With the rapid extension of our railroad systems, these figures will be proportionately increased. From these facts it would seem that the subject of forestry should receive the most favorable consideration from railroad corporations.

FOREST ECONOMY NECESSARY.

Statisticians have furnished us with alarming facts relating to the consumption of forestry products in this country and the consequent rapid decrease of our forest area. These facts have been widely published through official reports and commented upon by the public press. Yet so important are they as the basis for urging upon the people and the National and State governments the necessity for adopting and enforcing measures looking to the prevention of timber waste and preservation of necessary forest areas that I venture to repeat some of them here.

Prof. Egleston, Chief of the Forestry Bureau, at Washington, from the mass of statistics gathered on the subject, estimates the total value of all the annual products of our forests at not less than $800, 000,000, outmeasuring the value of our great cereal crop, that of corn; about double our wheat crop; more than that of our crops of hay, rye, oats, barley, buckwheat, potatoes, and tobacco taken together, and ten times that of all our mines of gold and silver. Prof. Sargent made the estimate for 1880 of more than $700,000,000.

The capital invested in the United States in lumber business–*i. e.*, in the business of manufacturing lumber, in 1880, was, according to the census return, $181,186,122. The total value of our lumber product for that year is given at $233,367,729, while the estimated value of the cord-wood used for domestic purposes was $321,962,373.

The New England States had invested at the same time in the lumbering business $16,641,326, and produced a lumber product valued at $19,271,914; and the value of the cord-wood used for domestic purposes that year amounted to $16,242,801.

In Vermont there are over 100 steam mills, which have sawed and manufactured from 1,000,000 to 18,000,000 feet of dimension stock from the log during the season of 1885. The aggregate production of lumber, timber, chair stock, etc., is estimated by measure to aggregate 232,000,000 feet the past year. This amount was all produced from whole sale establishments for shipment to dealers and markets outside the state. These figures also represent nearly the amount transported by the railroads to points outside the state during the year.

In addition to the large steam mills mentioned there are some 600 smaller steam and water mills in the state for sawing, dressing and manufacturing, lumber of various kinds. The average annual production of these smaller mills, is from a few thousand to one million feet. A part of their production is shipped to other states, but the greater portion of the lumber is used by local builders or sold to manufacturers in the state.

In regard to the material and stock produced by the large mills for exportation by rail, probably 80 per cent was spruce, and the balance hemlock, pine and hard wood. The manufactured value of this 232,000,000 feet of lumber and dimension stock is estimated by experienced lumbermen to average at least $15 per thousand, which gives an aggregate amount of $3,480,000 as the sum realized by Vermonters in this branch of industry.

The lumber of all kinds manufactured along the line of the various roads and shipped by rail to markets outside the state in 1885 should be apportioned about as follows:

	Feet.
St. Johnsbury and Lake Champlain	80,000,000
Passumpsic and South-eastern (road in Vermont)	60,000,000
Central Vermont and branches	40,000,000
Montpelier and Wells River	10,000,000
Bennington and Rutland	10,000,000
Other roads	5,000,000
	205,000,000

This amount is all of Vermont "stumpage," and does not include logs or lumber cut from Canadian soil and sent over Vermont roads. In addition to this it is estimated that nearly 30,000,000 feet of lumber is manufactured in Essex county and shipped over the Boston, Concord & Montreal and Grand Trunk roads to market. To transport this vast product of Vermont forests required over 20,000 cars, or 1,000 trains of 20 cars each. Also about 50,000,000 feet in log by Connecticut river.

The average number of men engaged in logging on a large scale in the state during the "season" exceeds 3,000. There are at least 4,000 men engaged in lumber manufacturing in the larger mills of the state, and probably 3,000 more that work in small saw-mills during the busy season of the year. It is probable that the lumber industry gives employment to 10,000 hands in Vermont for a portion of the year.

LOGGING IN ESSEX COUNTY.

The heart of the lumber region of the state is in Essex county. It is estimated that there is nearly 200,000 acres of timber land in this county, most of which is virgin forest. This forest primeval has an average width of twelve miles and is some thirty miles long, and old lumbermen say that it contains no less than 875,000,000 feet of spruce and hemlock lumber. It is expected that 80,000,000 feet of logs will be cut from the stump during the season of 1886–87. At this rate it will take but ten years to exhaust the supply of timber in this region. This vast forest is a mine of wealth to the owners, chief among whom are the Beattie Brothers, who own about 50,000 acres of woodland in Essex county. Messrs. A. M., D. H. and T. G. Beattie are entitled to be called the lumber kings of Vermont. They intend to cut over 20,000,000 feet of logs next season in Essex county alone. Is it not time for Vermont to awaken in regard to the future?

When the forestry bulletins, issued by Prof. C. S. Sargent from the Census Department, announced that in both the upper and lower peninsulas of Michigan there remained of standing white pine timber, suitable for market, but 35,000,000,000 feet, board measure, and that in the census year of 1880 there had been cut in the State 4,396,211,000 feet, requiring only eight years at this rate to exhaust the supply; that in Wisconsin there were standing 41,000,000,000 feet, with a cut of about three billions (2,097,299,000) feet for that year, leaving a supply that would last but fourteen years; that in Minnesota there were remaining 8,170,000,000 feet, and that 541,000,000 (540,997,000) were cut in the census year, leaving a supply for fifteen years, that at this rate the supply of white pine lumber would be exhausted in these three States in the brief period of about twelve years, the question of the future supply of this most valuable timber became serious to the business world.

The late James Little, of Montreal, in 1882, said of the supply of white pine in Canada that he had consulted with the best authorities, and was pursuaded that, at the rate of cutting then going on, the whole supply of the provinces of Quebec, Ontario, New Brunswick, and Nova Scotia would be used up in about ten years. According to these estimates, then, the supply of white pine will soon be exhausted, and the mechanic arts will have to look to other fields for their supply of wood and timber. In view of this vast industrial interest the protection and conservation of our forests demand the earnest attention of our people and of the National and State Governments.

RAISING TREES FROM SEED.

As I believe I have shown that forestry is profitable of course those that may wish to engage in it will require some directions about raising their trees from seed, and I believe I can do no better than make copious extracts from the directions given by Jackson Dawson, before the Massachusetts Horticultural Society, in 1885. He says: "It is an old subject, one that has been spoken and written upon from time immemorial to the present day. But we are a new generation and notwithstanding all that has been said upon the subject there are many who hardly know anything about the life of a tree, or how long it takes its seed to germinate. Yet there is no reason why every man who has a few acres of barren land should not plant a few acres of trees every year, using the kinds most suitable to the soil of his farm, thereby not only securing a permanent investment for his children but at the same time adding to the resources of his country.

"The raising of trees from seed is the natural way of propagating them. Nature shows us that, and employs many agents to carry out her designs. In the first place, seeds drop from the trees to the ground and are covered by the falling leaves, or by the grass and weeds, which keep them from the drying winds until they germinate. They are scattered by the winds, and many fall in the crevices of rocks, and on good ground, or other favorable situations; they are floated down rivers and brooks and are left in the rich mud along the banks. They are carried many miles from their original station by the birds; and the larger seeds. such as acorns and nuts, are carried away by squirrels, mice, and other animals, and buried for future use as food, and a great many of these germinate. I think that for many rows of fine oaks and hickories along the boundary walls of old farms we are indebted to the planting of the squirrels. While we can learn much from nature, we can also improve upon her methods, and supply ourselves with trees in an economical way. It is true, if nature is left to herself, and men stop detroying, she will soon cover up the ruins made by man, for she sows with a liberal hand; but there are so many conditions to take in to consideration, that only a small percentage of the seed that drops to the ground germinates; possibly not one in a thousand comes to maturity. For this reason we cannot afford to raise our forests as nature shows us.

"The sowing of tree seed where the trees are to remain is poor economy, and should not be undertaken except where it is impossible to plant; such sowing should be the exception, not the rule. A much greater quantity of seed is required; it necessitates more labor; more spots have to be replanted, and it is not generally satisfactory in its results. The soil and situation are so varied that the seed cannot be cared for, as it can be in the compact form of frames, seed beds, or nursery rows, where they can be protected from insects or inclement weather.

The first consideration in seed-sowing is to determine what you want to plant; the second, to procure your seed as fresh as possible; the third, to prepare a suitable soil and situation to plant them in; the fourth, to know what depth to cover them and how long to wait for the seed to come up.

For the first proposition I would refer you to the list of trees of Vermont published with this article.

The second your own judgment under the following directions will aid you while the third and fourth I shall endeavor to show you in the following remarks.

SOIL AND SITUATION.

In selecting a place for the seed beds the soil for all large seeds should be deep, rich, mellow loam, avoiding if possible all thin gravelly soils, or heavy clays. The soil should be well manured with good rotten manure one year old, and plowed or trenched from twelve to fifteen inches deep, and well pulvirized with a harrow. All coarse stones, witch grass, or other rubbish, should be raked off so as to leave the land in the finest condition possible. If the land is full of weeds it would be well to manure heavily and plant one year with crops that would be well cultivated; or to plough it frequently during one season, so that it may be as clean as possible when the time comes for sowing. If there is anything that tries one's patience, it is attempting to grow seedlings in a soil that is already full of weed seed. The land should be well sheltered from the north and west winds, either by a hedge or fence. If it is springy or low it should be well drained. If the seeds are to be sown in beds they should be laid out five feet wide, with an alley or pathway two and one half feet wide; this will give ample room to work the beds from both sides. The beds should be raked fine, and if to be sown broadcast they will then be ready for the seed. A great many people prefer to sow broadcast; but I think that method requires more labor and care in weeding. I prefer to sow in rows nine inches apart across the bed,—especially if there are a large number of varieties, or only a limited number of plants are wanted,—or in long nursery rows eighteen inches apart if to be worked by hand, or from two and and a half to three feet if to be cultivated by horse-power. The reason I prefer the short rows is that in beds so planted you can keep the soil well stirred between them, which you cannot well do when sown broadcast; they are also easier to shade and water, if necessary, than the long nursery rows, and in the fall they are much more easily protected.

SOWING.

The seeds should never be sown when the ground is wet, or when it is raining; the soil at the time of sowing should be neither wet nor dry, but in such condition that it can be raked without clogging. If sown when wet the soil is apt to bake hard, and a great many seeds will scarcely come through, while, on the other hand, if the soil is too dry the seed is apt to work out unless covered deeper than is desirable.

A supply of water should always be at hand ready to use during dry weather on all light-rooted plants; but for large, deep-rooted plants this is unnecessary, except in protracted droughts. It is also well to have a number of light lath screens to shelter the most delicate plants from the hot sun. Having the ground well prepared, and all else necessary, we can begin sowing as soon as we can get the seed. If in the fall, we begin with the oaks, as acorns do not long retain their vitality, out of the ground. Neither does the seed of chestnut, butternut, hickory, or beech. To insure good success these must all be planted, or put in boxes of earth, as soon as possible. If sown broadcast the nuts should be scattered thinly and evenly over the bed, pressed down with a light wooden roller, or the back of a spade, and covered a little more than the diameter of the seed,—which would be nearly an inch for beech, chestnut, and oak, and from one to two inches for hickory, black walnut, butternut, and horse chestnut. If the same seeds are sown in drills they should be from two to three inches deep, and from one to two inches apart in the row. If not pressed down they will need from half an inch to an inch more covering than those pressed down. Some prefer to make shallow drills with a plough and sow the nuts very thickly; this will give a great many more plants to a given space, but they will not be so strong.

The Maples, with the exception of *Acer rubrum* and *Acer dasycarpum* (these two species ripen their fruit in May and June), should be sown as soon as possible after gathering, and, whether in drills or broadcast, should not be covered more than twice their diameter. If covered too deep they will sprout and rot, not having strength enough to break through a great depth of soil. If maple seed is allowed to get perfectly dry, and is kept so until spring, very few, if any, will come up until the second year; while, if sown as soon as gathered and subjected to a good freezing, the greater portion will come up the following spring; though a few may wait until the second year.

The Ash (Fraxinus) must also be sown as soon after gathering as possible, if wanted to come up the first year. The Carpinus (Hornbeam) and the Ostrya (Hop-Hornbeam), unless sown in the autumn, will not come up until the second year. The Nyssa (Tupelo), *Cornus florida*, *Amelanchier Canadensis* (Shad-bush), *Celtis occidentalis*, the viburnums and thorns, seldom come until the second year, although there are a few exceptions, as some varieties will come if exposed to freezing, while of others not a seed will germinate even if frozen. The plum, peach, apple, and pear never come up evenly the first year unless the seed has been frozen or kept in boxes of moist earth. A great many roses will not come up the first year, even after having been frozen, although the seed of hybrids will, if frozen for a week or two, come up in less than a month. The Tulip Tree invariably takes two years, and, as the proportion of good seed is as one to ten, it should be sown very thickly to insure even an ordinary crop, I find a good plan, which saves much time and labor, is to to take some good-sized boxes, and fill with seed and fine sand in alternate layers; burying each box in a well-sheltered place and leaving it there one season, lifting out the sand in the spring and sowing the seed thickly in rows, and covering lightly.

Such seeds as those of *Cercis Canadensis*, *Gleditschia triacanthos*, *Cladrastis tinctoria*, and *Gymnocladus Canadensis*, being very hard, should have boiling water poured over them, and then stand for twenty-four hours, when they may be passed through a sieve, the mesh of which corresponds to the size of the seeds to be operated upon. All those not passing through the sieve may be considered fit for sowing, while the rest should be treated to another hot bath until they have all swollen to the required size. If sown dry they will keep coming up a few at a time for a year or two. The Ailanthus, Catalpa, Morus, Platanus, Birches, and Alders are best sown in spring, as soon as the ground is dry enough to work. The ground should be very fine, and, whether in beds, broadcast, or in drills, the seed should be very lightly covered; and if a slight screen or shade were used it would be of great benefit to the young seedling until they had made the second or third rough leaf, when the shade could gradually be dispensed with.

The White and Scarlet Maple, the Elms, and *Betula nigra* ripen their seed in early summer, and should be sown in freshly prepared beds as soon as gathered. At this time of the year the weather is often quite warm and dry, therefore these summer sown seeds should be carefully attended to as regards watering, and possibly light shade should be given. Where a large amount is planted, and no screens are at hand, birch brush laid thinly over the bed is a great help. If well taken care of they will make plants from six to twelve inches high the same season. I would say, before going further, that my rule is always to cover seed sown out of doors in any ordinary loamy earth a little more than their own diameter, and if very light and sandy nearly twice as deep, but if the soil is a clay, as lightly as possible; and it makes no difference whether broadcast or in drills. I know there are a few trees whose seed will come up if covered quite deep, but they are exceptions, not the rule.

Such seeds as those of Magnolia, Rose, Mountain Ash, Cratægus, Celastrus, Euonymus, and Viburnum, which are inclosed in a fleshy pericarp or pulp, where space is of account, and also for convenience of sowing, I macerate in water at seventy or eighty degrees for one or two weeks, when they may be washed out and sown before they are thoroughly dry. This often helps germination, and more in the magnolia than any other plant I know. If the magnolia is sown when gathered, there is an oil in the pulp that surrounds the seed, which, as soon as it begins to rot, seems to penetrate the seed and make it rancid. I have frequently noticed that of the seed of the magnolia that was not washed clean, few germinated; the pulp, in rotting, so soured the soil that it became full of fungus, which damped off many of the young plants, necessitating their removal to fresh soil to save them; while of those washed and sown under the same circumstances all came up and grew well. Of course this may not occur in nature, where the seed is exposed to the air and weather, or eaten by the birds and voided: but I am speaking of artificial cultivation. When magnolia seed is to be sown out of doors in New England it is best, after washing it out, to put it in pots or boxes of sand,—that is, in alternate layers of sand and seed,—and place it in a frame or cellar, where it does not freeze, until the the time of sowing in May. This is a good way to keep seeds for which we may have no place prepared, or which may arrive in late fall or winter, when it is impossible to get them into the ground. Very often it is more convenient to put seeds away in this manner until spring, than to sow in the fall; but it will not answer for seeds which need frost.

When seeds are sown in the fall it is well, as soon as the ground is frozen, to cover the beds or rows with a light covering of hay, pine needles, or leaves; which will keep the ground from heaving, and the heavy spring rains from washing up the seeds. If closely looked after, the covering may be left on until the seed shows signs of germination, which, in the case of large nuts, will be in June, when it should be carefully removed; this will also save a great amount of weeding.

All seed beds and rows should be kept free from weeds and, except where sown broadcast, as soon as up the ground should be hoed or cultivated frequently; this causes the young plants to push with greater vigor, and makes them better able to withstand drought. If the weather becomes very warm and dry the beds or rows of young seedlings should be well watered once or twice a week,—not by a slight sprinkling on the surface, but by a good thorough soaking, wetting the ground six or eight inches in depth. After the first of September the wettings may be discontinued, to allow the plants to ripen up their growth.

At the approach of winter all young seedlings that were sown in drills will stand better if a plough is run between them throwing a furrow against the stems, so as to cover them several inches deep; this keeps the young plants from heaving with the frost, and also keeps the water and ice from settling around the young stems, which often causes great injury. Those sown broadcast should have a slight covering of hay or leaves, as soon as the ground is frozen, which is usually from the twenty-fifth of November to the first of December in this vicinity.

SECOND YEAR'S TREATMENT.

About the first or second week in April the covering should be removed, the young trees carefully taken up, and the tap roots cut well back; the cuts should be clean and smooth, so they will quickly callous and send forth plenty of young fibers, which would take some time if the cuts were not smooth. If any of the tops are crooked they should be cut back to a good strong eye; this will cause them to make a straight leader. When taking up the young trees, they should not be exposed to drying winds, or hot sun, even for a few minutes, but as soon as taken up they should be tied in bundles, and the roots well sprinkled with water, and covered with a mat, or piece of old bagging, and kept moist until they are planted. There is no doubt that a great many failures in tree planting could be traced to the drying up of the roots before planting, and it has often been a wonder to me how some trees grew at all, considering the treatment they received.

THE NURSERY.

Having a good piece of land well prepared, either by trenching or ploughing, mark out rows three feet apart with a spade or plough; if with a plough go twice in a furrow, which will usually make the drills deep enough for trees one year old, and, if they are to remain only one year, one foot apart will do for the larger growing kinds, and six inches for the smaller ones; if to remain a longer period a much greater distance will be required.

In transplanting trees the roots should be well spread and the soil worked well in about them, and well firmed with the feet. Our seasons for planting are often so short that we have to plant in all kinds of weather, though it is best not to plant when the ground is wet if it can be avoided. The best time is when the soil is dry enough to crumble easily; it can then be worked among the finest roots, even if there are a great many of them, by taking hold of the tree and giving it three or four good shakes as the soil is being spread around the roots; but it is hard work to get it among the roots when it is wet and pasty. After planting, weeds should never be allowed to get a foothold in the nursery, but it should be cultivated at least once every two weeks, and all weeds cut out with a hoe between the plants. This will help the tree to withstand a long drought much better than it otherwise would, and at no great cost.

At the end of the second year almost all deciduous trees, if for forest planting, will be as large as it is profitable to plant in large quantities. If wanted for ornamental purposes they will need to be transplanted at least every two or three years, and carefully pruned into proper shape until they have reached the desired size. If often transplanted they may be successfully removed when from fifteen to eighteen, or even twenty feet in height; though I believe that vigorous young trees, from one to three feet high, when set out where they are to remain, will make much finer specimens if soil, preparation and care be equal.

THE CONIFERS,

Such as pine, spruce, larch, cedar and hemlock, require much more attention and care to grow from seed than any other class of trees, and many of the finest kinds it is impracticable to raise out of doors in our New England climate, though the common ones with care and attention may be raised quite successfully. The ground for these seeds should be a light, rich loam, deep and well pulverized, or, if not rich, made so with a good dressing of well decomposed manure. The beds should be laid off five feet wide, and the alleys three feet. Along both sides of the beds, at intervals of five or six feet, drive a row of small posts that will rise six or eight inches above the surface of the beds. The beds should be a few inches higher than the paths, so that water will not stand on them. The situation should be as sheltered as possible both from the midday sun and drying winds; the north or east side of a hedge or fence is a favorable position. The beds being all prepared and raked very fine, as soon as the weather becomes settled—say from the 10th to the 20th of May—the seed may be sown thinly, in rows six inches apart, across the beds or broadcast, and slightly covered, certainly not more than twice their own diameter. The sowing in rows is most convenient in working them, both in the way of keeping the beds clean and stirring the soil among the young plants. If sown broadcast they should be lightly raked in and the bed rolled with a light wooden roller. I would here say that all seeds sown during warm, dry weather are much benefited by having the ground lightly rolled over them. The sowing being completed. place on the posts before mentioned lath screens made the width of the bed, with the laths not more than an inch apart. This will screen the plants from the sun and in part protect them from the birds, which often pick up the young seedlings that are just breaking ground. If no laths are handy the seed beds can be covered with pine, hemlock or cedar branches, quite thickly at first; but the beds must be watched carefully, and as soon as the young plants begin to appear the branches should be gradually removed, until only enough are left to slightly shade the young plants, and these should be raised some inches above the plants. It is a good plan where pine needles are plenty to cover the seed bed thinly between the rows with them; this keeps down the weeds, saves much watering, and keeps the soil from washing or baking. If the ground is very dry at the time of sowing they will require a slight watering; otherwise they will not need it. In my experience there are few seeds that require so little water as those of conifers during germination.

The critical time with young conifers is the first three months of their existence, until they have made the crown bud; after that time there is very little danger, but until then extreme watchfulness is very necessary; a great quantity of rain or a scorching sun will often prove fatal to thousands. Stirring the soil after heavy rains, and tilting the screens as soon as the sun is gone from them, or sifting dry soil amongst the beds of overwet seedlings, is of great benefit. After the muggy weather of August is past they will require very little care the rest of the year. At the approach of cold weather they are best protected by a slight covering between the rows, and a few pine branches or a little meadow hay spread over the tops of the young plants will keep them in good condition until spring.

The pines, such as the Scotch, Austrian and Red, should not stand more than one year in the seed bed without transplanting, unless sown very thinly. The White, Black and Norway spruces will hardly be fit to transplant until the end of the second season. The larch makes better plants if transplanted at one year, but will stand two if thinly sown. The Silver fir, Balsam fir, hemlock, and others of that section may stand in the seed bed two years, while the Arbor Vitæ should be transplanted after the first season. The seeds of the

Juniperus and Taxus, of all species, do not germinate until the second year, and it is well to treat them as I have recommended for all slow growing seeds. The *Pinus Cembra* and other stone pines will lie in the ground until the second year, though a few may come up the first.

The seeds of the conifers, with the exception of the silver firs, will, if kept in a cool, dry place, retain their germinating powers for a number of years, and even under adverse circumstances. A few years ago we had some branches of *Pinus contorta* sent us, which had the cones of six years upon them. Each cone was opened separately and the seed carefully sown and labelled, and a portion of all but one grew, and that one was only two years old, while the oldest represented the seventh year. White, Scotch, Austrian and Pitch pine seeds came up fairly after being kept five years, and might possibly have been several years old when received. I have found in my experience that too much moisture is fatal to the germination of old seeds, especially resinous or oily ones. If sown in soil that is barely moist, and covered with dry sphagnum so as to prevent the escape of the little moisture in the soil, many will grow; while if treated in the ordinary way the seed will swell and then rot.

A friend of mine, who does not like too much care, has a very simple way of raising annually several thousand seedlings of the Norway spruce, and no doubt other evergreens might be grown under similar conditions. At the back of his house he has a white pine grove, which is trimmed up ten or fifteen feet; the soil is a light, sandy loam. In this he digs several beds, rakes them fine, and early in May sows the seed, rakes it in lightly, and sprinkles the bed lightly with pine needles. If the weather is very dry he gives the bed one or two waterings; if not dry he lets it in a great measure take care of itself. In these beds the seedlings remain two years, when he transplants them into nursery beds, where they soon make nice young plants.

THE BOX SYSTEM.

The remarks that I have made would apply to those who wish to raise trees in large quantities, and where the loss of a few hundreds in transplanting would be of no material account. To those who might wish to plant an acre or so every year and want no failures, I would recommend another system which requires less space and labor, though possibly more attention, but in the end any one could transplant the most difficult trees, such as oak, hickory or chestnut, with no loss. For want of a better name I have called it the "box system." No doubt it has often been used, but I have not heard of any one using it largely except myself. By this method every root is preserved, and not even a fiber is destroyed; there are few if any large tap roots to cut off, and even if grown in the nursery afterwards they lift with finer roots than the seedlings grown in the ordinary way; and though they will not make so vigorous a growth the first year as they would in the open seed bed, at the end of the second year after transplanting they are ahead of those of the same age grown in the ordinary way, and with no failures. Nine years ago we transplanted from the seed boxes to a hillside in sod ground with no preparation, except to turn over the sod with a spade where each tree was to go, some hundreds of oaks one year old, and today they are fine young trees, from six to nine feet high, well formed, and much more vigorous than those grown in the nursery, which have had a great amount of care and labor bestowed upon them. I believe that if many of our early planters had used this system in growing oaks, hickories, and other hard wood trees, they would not have had so many failures to complain of.

In the first place procure a lot of common boxes, such as may be had at any grocery store; any kind of boxes will do, though a uniform size is best, as they occupy less space in a six-foot frame when packed away than boxes of various sizes would. I usually get those that have contained canned goods or soap, as they are nearly equal in size, and with two cuts of a splitting saw you have from each box three flats from three to four inches deep, which is a good depth for any ordinary seed. With a half inch auger bore three or four holes in the bottom of each box for drainage. This will be sufficient for large-rooted plants, while the finer seeds will require to be well drained with broken pots, coarse siftings of peat, or any coarse material that will allow the moisture to pass off readily. As soon as the seeds are ripe in the fall, get together a good pile of compost, made as follows: Two parts rotten sod, one part peat, and one of sand, and if the seeds to be sown are oak, hickory, beach, chestnut or walnut, add a portion of good rotten manure. For such seeds as I have mentioned fill your boxes two-thirds full of the compost, and press down firmly with a board or the hand. Sow the seeds evenly and press them down in the soil, covering them from half an inch to an inch in depth, according to their size. On one corner of each box smooth off a place with a plane or knife, rub over with white lead, and write the name of the seed and the date of sowing. This takes only a few minutes, and is of much value afterwards, especially where a great variety of seeds is sown. It is much better than labelling in the ordinary way, and there is no danger of the record being lost in moving the boxes from one position to another. The finest seeds—such as maples, elms, birches, alders, and others—should be covered, according to the size of the seeds, about their own diameter. After sowing, the seeds should have a good watering with a fine nose to settle the soil. The boxes can then be piled four or five feet deep in a pit, the sashes placed in it, and at the approach of cold weather they may be covered with meadow hay or leaves. This does not keep the boxes from freezing, but when once frozen it keeps them so until spring. If no pit is available the boxes can be piled six or seven feet deep in a well sheltered spot, covering the upper boxes with a few boards, the whole to be covered with leaves or other litter. In the case of all the seeds I have mentioned as taking one or more years to germinate it is unnecessary to cover the boxes with litter; but it is well to cover with boards, so that mice or squirrels may not get at the seed; and in many cases seed that has been so frozen will often come up the first season, which otherwise would not have come until the second. As soon as the weather is settled, which is usually about the middle of April, choose a well sheltered spot, level, and handy to water. If the aspect can be an eastern or south-eastern one I like it better, as they get the early morning sun, but not the scorching sun at noonday. Place all the boxes containing the nuts, acorns, and other large seeds together in beds of three boxes wide. This will make all very compact, and much easier to care for than if the boxes containing seeds of the same class are scattered about. The only attention these will require is to keep them well watered and free from weeds; but for such seeds as maple, ash, elm, and others of like nature, it would be well to cover the boxes with lath screens until they have made the second or third rough leaf, when they might gradually be hardened off and finally exposed fully to air and light. If a few sashes could be spread to protect all delicate growing seeds it would be of great advantage, and as soon as well up they could be treated the same as the others.

The use of lath screens on seed beds saves a great amount of labor in watering, and if the plants are neglected for an hour or so the results are not so disastrous as when the young seedlings are fully exposed to the sun. Any boxes of seeds that do not come up before the last of June will hardly appear that year, but will require to be kept moist, the same as the growing plants. I usually place all such boxes together in a shady spot and cover them to the depth of an inch or more with sphagnum moss, and by giving them a good watering once or twice a week they are carried safely through the summer. At the approach of cold weather they are gathered together, piled five or six deep as before, and covered for the winter. When spring comes on they will need to be treated as seed that has just been sown. For the finer seeds, such as azalea, rhododendron, kalmia, and others, a special treatment is required.

In the fall of the first year the boxes of young trees may be gathered together and wintered in a deep pit or frame and slightly covered with meadow hay. If no frame is available, three or four inches of pine needles or leaves may be placed over the boxes, and they may then be left until spring; but on no account should the boxes be left without any protection, as the young seedlings will then suffer very much in so little depth of soil.

All seedling trees can be transplanted when very young as easily as cabbages or tomatoes if taken as good care of, and many of them are benefited by the operation. We transplant thousands of them every year with but little loss. The best time is when they are making their first or second rough leaf.

In the spring of the second year all the young seedlings should be transplanted from the seed boxes to the nursery beds, or the larger ones planted out; and for chestnuts, hickories and oaks, I believe it is best to plant them from the seed box to the field where they are to remain. If planted in nursery beds or rows, the treatment will be the same as I have spoken of under the head of treatment in nurseries.

The boxes I have mentioned are usually from fourteen to sixteen inches square, and will hold from 100 to 125 oaks, hickories, chestnuts, or beeches; 175 to 200 ashes or maples; 250 birches or elms; and so on according to the growth of the plants. Where a greenhouse can be used for this purpose, with frames to harden off the young seedlings, much better results can be obtained, and many of the finer seeds can be grown, which it is next to impossible to grow in large quantities out of doors.

In conclusion I would say that, while I have not mentioned every tree by itself, the general principles are the same for all; that as a rule the soil should be of the best description and sheltered; that all seeds should be covered only a little, if any, deeper than the diameter of the seed; that they should be kept clean from weeds, the watering well looked to, and the shading, in the case of the finer seeds, be carefully attended to. They should be protected the first season, and in the end will well repay all the care and attention that have been bestowed upon them; and any one owning a few acres of land, who will plant a few boxes of chestnuts, black walnuts, beech, oak, hickory, or other hard wood trees, that are usually considered so difficult to transplant, after growing them one year in the boxes and transplanting the following spring where they are to remain, will be astonished to see how much land can be covered in a few years with healthy young growths of hard wood with very little trouble or expence. And in New England, as well as in other parts of our country, we have too many acres lying idle, which it would be more profitable to plant with trees than anything else.

PLANTING TO STAND.

Notwithstanding Dawsons' ideas I believe, to start forests of oak, hickory, walnut, and all other heavy seeded trees, it is best and cheapest to plant the seeds just where the trees are to grow. One method of planting acorns and nuts, in practice by the Tharandt Forest Academy, of Saxony, is as follows: Take a stick sharpened at one end and shove it obliquely into the earth to the depth of two inches, not more (in hard or stony ground, the pick is used), put in the seed and press the soil above it down firmly with the foot. The seeds should be placed about three feet apart.

In my experiments I find that in the maple the seed planted where it is to stand will outstrip in growth the transplanted maple, transplanted at five years old in from ten to fifteen years, and that the result is more perfect trees.

If not so propagated they must be set at one or two years of age. These little trees can be planted very rapidly with a hoe or spade. Dig a small hole a little deeper than the roots; hold the plant vertically with the left hand, and with the right draw the soil carefully around the roots, and press it down with the hands and foot. If there are stones near by, place a few around the plant; they will help keep the surface moist, and prevent the weeds and grass from growing.

Nearly every one who lives in the country at some time plants trees, but how few know just how to do it properly!

At the outset it is necessary to bear in mind that the tree is a living body, and that the process of removal interferes with its functions, and when it is displaced from the ground, causing an arrest of the circulation that is constantly going on between the tree and the soil, a severe shock is sustained. Every root-fiber destroyed lessens by so much the chances of success, and when a greater portion of these are gone, the tree is forced to depend on its own vitality to supply a new set of rootlets before growth can take place.

In the beginning bear in mind that it is important not to injure the roots and to preserve as many as possible, particularly the small ones, for these are what must be depended on to start the growth in the new life. Where trees are dug up to be removed a short distance, preserve all the roots if possible.

When the tree is out of the ground, exposure to the sun or drying winds will cause evaporation, which is very detrimental to the tree, and is a common cause of failure, and one which is often overlooked. If, however, the tree has become shriveled and dried, vitality may often be restored by burying the whole tree for a few days in moist soil; but it is far better not to have it get in condition to need any such remedy, which at best can not restore the tree to its original condition.

In excavating holes for planting, it is not necessary to dig very deep, unless for a tree with a tap-root; it may even be hurtful in a hard soil by affording a place to hold water under a tree to its injury. The roots of young trees grow near the surface, and the holes should be large enough to allow the roots to be extended their full length without cramping or bending.

In case it is very dry at the time of planting, it is a good plan to puddle the soil around the roots, always covering with dry earth. In this way moisture will be retained for a long time. Avoid too deep planting. The roots must not be placed beyond the action of the air; about the depth they were before removed, or a very little deeper, When filling, press the earth from the first firmly, so as to leave no spaces, and have it compact about the roots. This latter point can not be too thoroughly attended to, and, of course, to do this well, the soil must be finely pulverized and no lumps be allowed in the filling. It will be necessary to use the hand to place the soil in spaces where the spade cannot go.

The best time of setting is when the soil has settled in the Spring and become warm, so that trees not being removed begin to start. Earlier than this is not so well, for the sooner the tree begins to grow after being set the more likely it is to do well. We believe the proper time is the Spring and that it is the best time for planting all kinds of trees, although early Fall planting is often recommended. Evergreens often suceed well when planted in August; still we would rather risk them in the Spring, just as they are ready to grow. When you would plant early potatoes is a good time to plant trees. Evergreens are the most sensitive of any to drying while being removed, and if once allowed to become dry it is all day with them; no amount of pains or trouble can restore the lost vitality. For this reason they can be removed but short distances unless very carefully packed.

As more or less of the roots are removed or injured, it is necessary to prune the top when transplanted. This has generally been done by cutting all the branches back; but a better way is to remove a portion of the branches, leaving those strong ones that are in position to give the tree a well-shaped top. If all the branches are left, and the proportion between the tops and roots balanced by cutting all back, in after-growth some of these branches will require to be removed—an injury, perhaps to the tree. This certainly will apply to fruit-trees. Sometimes trees for ornament or shade require to be cut back to make a thicker top or one more symmetrical. Large trees are removed in winter with a large ball of earth attached to the root, and, though a heavy job, it is the only successful method of doing it. A trench can be dug at the proper distance around the tree, and filled with coarse litter previous to freezing, and also the holes to receive the trees may be dug, which will much facilitate the labor.

Small trees do better than large ones, and it is better to be to the trouble of taking care of them one or two years longer than to have them grow too long in the nursery row. Trees grown on good soil are better than from poor soil. They have more and better roots, and are in better condition to grow in their new location. Of course, it is not desirable that the soil where they have grown should be so rich as to produce such a growth that the wood will not properly ripen, but it should be one sufficient to make a strong, healthy tree. A tree in poor soil has weak, spindling, feeble branches, and, like a starved animal, take as long time to recover, even when placed in better soil with better feeding.

After large trees are properly transplanted they should be staked, to prevent swaying around by the wind. When the ground is soft the movement of the top creates a displacement of the roots before they have taken any hold of the soil, resulting in injury or death to the tree. Mulching must not be dipensed with. Its object is to keep the soil moist until the roots obtain a strong hold. This may be overdone. Mulch for shade only. A large mass of decaying matter is more hurtful than beneficial. We cannot avoid all risks in transplanting; but if these conditions, which we repeat, are followed, the risk will be very much lessened: Careful removal, protection from drying while out of the ground, setting in warm well-pulverized soil, hard tamping the soil about the roots, judicious pruning, staking, and mulching.

All this requires care and labor; but it will make the difference between a thrifty, profitable orchard and a sickly and unprofitable one, or a fine-formed, well-grown shade or ornamental tree and a stunted unhealthy specimen, which has no beauty or gives no pleasure.

If the trees are large, cut the top well back. The elm will grow if cut back to a pole, yet it is not desirable to do so, but if left with a full top the chances are that the tree will die, wholly or partially, leaving the living portion in unsatisfactory shape. A most common mistake is that of leaving too much top. In case of the maple tree, however, the top should be lessened by thinning the branches, leaving the outline of the tree not much disturbed. This is necessary to secure the symmetrical, oval shape, which is the beauty of the maple. If great care be taken to secure all the roots, and as much earth as possible, a larger top than otherwise will be supported. If the tree stands upon a slope, take a spade and cut a narrow leading channel in the turf, which will conduct more water to the roots of the tree, in case of a washing shower, than it would receive without this help.

TRIMMING.

In trimming any trees, it is very desirable that they should be so small, that no limbs need be cut larger than an ordinary lead pencil, and then, that they should be trimmed each and every year, that no limbs larger than one years' growth be taken off. The cutting of large limbs is the death blow to the tree. It may struggle on for many a year, but at length rot at the heart creeps in and the tree dies. If it grows to large size, the timber is injured by the rot at the heart. In fruit trees, the black heart, the result of wounds, can be detected in the smallest limbs, and the purchaser of young trees should never receive or pay for such, if they have a dark almost black heart, for they are imperfect and will usually die before five years.

AGE OF A TREE.

There has been much question about the number of grains, or rings of growth, showing correctly the age of the tree. In my experiments I find it marks the periods of growth, yet in Vermont, that generally coincides with the seasons, in natural forests, but not in cultivated trees or in cleared land. A dry midsummer may cause two rings. A hail-storm that denudes the trees of their foliage will cause two rings. if the trees leave out again; and sometimes a considerable injury to a tree by the loss of its bark on one side in midsummer will cause an additional ring in the effort to heal the wound. In support of this I quote the following authorities:

Ex-Governor Furnas, of Nebraska, stated that the concentric rings of trees are no criterion of their age. As a rule, Mr. Furnas said, the number of rings were in excess of the age of the tree, but he had found one specimen, the age of which was absolutely known, which bore less rings than the age of the tree. He had another specimen which contained two rings for every year's growth.

Prof. Budd, of Iowa, invited attention to a specimen of white poplar, grown on the Iowa Agricultural College farm. It was a close grained timber, which does not warp or shrink, and he thought it would be a good substitute for the white pine. The specimen showed more than thirty rings, while its actual age was not more than fifteen years. Prof. Budd said that he had noticed that in dry seasons trees would produce two rings.

Mr. Minier, of Illinois, said he had cut this spring two pine trees he knew to be thirty years of age, in which the rings corresponded with the age, and in his opinion if the gentlemen would look a little further they would find that the timber in which the rings did not agree with the age, was cultivated timber. Nature never produced a double flower. Cultivation did that. So, in his opinion, as to the double ring, cultivation did the business.

Prof. C.E. Bessey, of Ames, Iowa, took the position that if two rings were produced in one season, there must have been two separate and distinct periods of growth that season.

TABLE 5.

VALUE OF WOOD.

Showing the Relative Specific Gravity and Approximate Full Value of the principal Vermont woods. Compiled from Prof. C. S. Sargent's Report on the Forest Trees of North America for the Tenth Census.*

Number.	Scientific Name.	Common Name.	Specific Gravity	Fuel Value.
1	Carya alba	Shell-bark Hickory	.8372	83.11
2	Carya tomentosa	Mockernut	.8219	81.29
3	Carya porcina	Pignut	.8217	81.36
4	Cornus Florida	Flowering Dogwood	.8153	80.98
5	Ostrya Virginica	Lever wood	.8284	82.42
6	Amelanchier Canadensis	Shad-bush	.7838	77.95
7	Quercus bicolor	Swamp White Oak	.7662	76.18
8	Betula lenta	Black or Cherry Birch	.7617	75.97
9	Carya amara	Bitter-nut	.7552	74.74
10	Quercus prinus	Swamp Chestnut Oak	.7499	74.42
11	Quercus alba	White Oak	.7470	74.39
12	Robinia pseudacacia	Locust	.7333	72.96
13	Celtis occidentalis	Nettle tree	.7287	72.08
14	Prunus Americana	Red Plum	.7215	72.02
15	Cratægus Crus-galli	Cockspur Thorn	.7194	71.54
16	Kalmia latifolio	Mountain Laurel	.7160	71.31
17	Ulmus fulva	Slippery Elm	.6956	69.77
18	Acer saccharinum, var. nigrum	Black Maple	.6915	68.66
19	Acer saccharinum	Sugar Maple	.6912	68.75
20	Betula lenta	Black Birch	.6553	65.34
21	Fraxinus Americana	White Ash	.6543	65.16
22	Quercus rubra	Red Oak	.6540	65.28
23	Ulmus Americana	White Elm	.6506	64.54
24	Fraxinus sambucifolia	Black Ash	.6318	62.72
25	Rhododendron maximum	Great Laurel	.6303	62.80
26	Fraxinus pubescens	Red Ash	.6251	62.35
27	Larix Americana	Tamarack	.6236	62.16
28	Acer rubrum	Red Maple	.6178	61.65
29	Betula papriace	Canoe Birch	.5955	59.40
30	Prunus serotina	Wild Black Cherry	.5822	58.14
31	Betula alba var. populifolia	White Birch	.5760	57.43
32	Acer dasycarpum	River Maple	.5269	52.52
33	Pinus rigida	Pitch Pine	.5151	51.39
34	Sassafras officinale	Sassafras	.5042	50.38
35	Juniperus Virginiana	Red Cedar	.4926	49.11
36	Populus grandidenta	Large Poplar	.4632	46.11
37	Picea nigra	Black Spruce	.4584	45.71
38	Tilea Americana	Bass-wood	.4525	45.00
39	Castanea vulgaris, var. Americana.	Chestnut	.4504	44.95
40	Tsuga Canadensis	Hemlock	.4239	42.20
41	Populus balsamifera, var. candicans	Balm of Gilead	.4161	41.42
42	Picea alba	White Spruce	.4051	40.38
43	Populus tremuloides	American Aspen	.4032	40.10
44	P. monilifera	Cotton Wood	.3889	38.53
45	Pinus strobus	White Pine	.3854	38.47
46	Abies balsamea	Fir Balsam	.3819	38.02
47	Populus balsamifera	Balsam Poplar	.3635	36.11
48	Thuja occidentalis	Arbor Vitae	.3164	31.53

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*The specimens used for specific gravity were dried at 100° Centigrade until they ceased to lose weight. The specific gravity was then obtained by measurement with micrometer calipers and calculation of the weight of the blocks. The relative fuel values are obtained by deducting the percentage of ash from the specific gravity, and are based on the hypothesis that the real value of the combustible material in all woods is the same.

TREES OF VERMONT.

In consideration of the interest in Forestry and the many enquiries about different trees, I have thought best to append a list of the various forest trees in Vermont, with some remarks upon them in relation to values, size and some of their uses. The authority followed is that of Prof. Gray, of Cambridge, and Sargent's Catalogue in the tenth census of the United States. When any of their common names are known they are given. It is not intended to make this list absolutely perfect as to do so would require more time then is at my command but I trust it is sufficient to answer all general questions in reference to the trees of our state.

Berberis vulgaris, L.

Common Barberry; naturalized from Europe; occasionally found within the oldest settled portions of the state. A shrub ten to fifteen feet high, with spiny branches. An excellent hedge plant. The bark and wood yield a yellow dye, and the handsome, acid, scarlet fruit is good for preserving.

Does not produce well in northern part of state. Not very abundant.

Zanthoxylum Americanum, Mill.

Northern Prickly Ash. Rare. It has escaped from cultivation in a few places. A prickly low shrub. The whole plant pungent and aromatic. Of use in medicine.

Might be of some profit to cultivate.

Vitis labrusca, L.

Northern Fox Grape. The species from which most of the cultivated varieties are derived. Common to the alluvial soils and rocky hillsides of the lower Connecticut valley. The fruit of the wild vine is often of good quality.

Vitis œstivalis, Michx.

Summer Grape. Has the same range as the preceding, and is distinguished from it by the leaves being slightly downy instead of white, woolly beneath, and the fruit about half the size, and usually less palatable. Varieties are sometimes found which are so much better as to show that it would soon improve if cultivated. In the South-western states this is the most common and best esteemed species.

Vitis riparia, Michx.

Frost Grape, Winter Grape. The most northern species, ranging as far as the foot of Fifteen-Mile falls on the Connecticut. Leaves heart-shaped, slightly three-parted, and smooth, except a few hairs along the veins of the underside. Fruit small, abundant, and of no value until after frost, when it may be useful in localities where better grapes are not to be had. All other species of grapes are good types of the Alleghenian flora, rarely being found native above six hundred feet from the sea.

Ampelopsis quinquefolia, Michx.

Woodbine, Virginia Creeper. Well known in cultivation. A handsome, tall, climbing vine, the shining leaflets in fives, and turning bright scarlet in autumn. Fruit the size of pease, bright blue. Common everywhere. Escaped from cultivation.

Rhamnus catharticus, L.

Common Buckthorn. A small tree, with hard, reddish or orange-colored wood, and small, nauseous, black berries. It is used for a hedge plant, for which purpose it was introduced from Europe, and it has become well naturalized in the south part of the state.

Rhamnus alnifolius, L'Her.

A slender shrub, found in cold swamps. Rare.

Ceanothus Americanus, L.

New Jersey Tea, Liberty Tea, Red Root. A shrub one or two feet high, forming rounded clumps. Flowers white. Dry sterile soils; near the Connecticut, at Bellows Falls. The leaves have sometimes been used as a substitute for tea.

Celastrus scandens, L.

Wax-work, Climbing Bitter-sweet. A twining shrub common near the Connecticut. The orange-colored pods open and display the scarlet fruit, and these remain all winter. Often cultivated for ornament, and reputed to be medicinal.

Staphylea trifolia, L.

A handsome shrub, sixteen feet high. Leaves in threes, and the bark striated with green. Because of the inflated pods it is called Bladder-nut. Only rarely to be met with, chiefly in the lower Connecticut valley.

Tilia Americana, L.

American Linden, or better known as Basswood. A large tree, to be met with in all parts of the state, to altitudes two thousand feet above the sea. In the southern part of the state it is found most abundantly near the streams, and when found on high lands, prefers a moist, fertile soil. It is common and best developed in the upper Connecticut valley, where specimens are often met with which are eighty to one hundred feet in height, with a diameter of from two to four feet. Bark very tough and strong, owing to its very coarse fibers, and can therefore be used for making coarse matting. Wood very soft, light, and elastic; useful for lumber, a good material for carving, and remarkable for the facility with which it can be moulded into various curved forms, and therefore much in demand for carriage-work. As bees derive an abundance of the best honey from its flowers, it is recommended by apiarians as a profitable investment, to plant as a source of honey. It is of very rapid growth, and its abundant foliage makes it very desirable as a shade-tree. It mattures in from fifty to one hundred years, but becomes of sufficient size for timber in twenty or thirty. Wood of little value for fuel, but the ashes very rich in potash.

Seeds in size and form resemble spice. They grow better if immediately planted when ripe, but will grow after moderate drying. The tree can also be propagated by cuttings. If transported they must be put in wet sand as the least drying injures their germinative power.

Rhus, Sumach.

Rhus typhina, L. Staghorn Sumach. The largest of the genus which grows in Vermont. A shrub ten to twenty feet high, with wide-spreading branches, the tips of which are covered with velvety hairs, which causes them to resemble the young horns of deer. Common everywhere up to two thousand feet altitude. Flourishes best in moist, rocky situations, and sometimes attains a diameter of ten inches. The orange or yellowish-green colored wood is capable of taking a good polish, and useful for small cabinet and ornamental work.

Rhus glabra, L. Smooth Sumach. Six to ten feet high, with smooth branches and leaves, and very large heads of fruit. Stem rarely more than two inches in diameter. This species is seldom seen on the highlands, but is common to the eastern part of the state and the lower Connecticut valley.

Rhus copallina. Dwarf Sumach. Usually four to six feet high, with the shining leaves winged along the petioles. Ranges with *R. glabra*. The leaves of this and the two preceding species are gathered in Virginia for tanning purposes. Perhaps the same use might be made of our sumachs, unless our season is too short for the best development of the tanning principle.

Rhus venenata, D. C. Poison Sumach. Often called Dog-wood, a name which properly belongs to *Cornus*. Common in the swamps and moist places of the southern part of the state. A handsome species ten to twenty feet high, with dark green, shining leaves, and slender racemes of white fruit. Wood in color similar to that of the Staghorn Sumach. This species is extremely poisonous to the touch to the majority of people, causing painful swellings and watery blisters on the skin of the parts which come in contact with it, and some are so extremely sensitive to its effects as to be poisoned if they stand within a few feet of it when the air is hot and moist. Others, on the other hand, can handle it, and even chew leaves with impunity, feeling no ill effects whatever. The milky juice is said to have properties similar to that of the lacquer tree of Japan, *R. vernicifera*.

Rhus Toxicodendron, L.

Poison Ivy, Poison Oak. A creeping and climbing shrub everywhere well known and common. Fruit white and leaves in threes. Poisonous like the preceding, but in a less degree. The climbing variety, the *R. radicans* of some botanists, is not very common here, being sometimes seen clinging to the trunks of trees and rocks, and becoming ten or fifteen feet high, with a stem an inch or two in diameter, but in the Mississippi valley it reaches the tops of the tallest trees, with a stem four to six inches in diameter.

Acer saccharinum, Wang.

Sugar or Rock Maple, the finest and most useful of the maple genus. In Vermont it is most abundant as a highland tree. It is a source of revenue because of its sugar and is the standard wood for fuel. It yields lumber which is very hard, heavy, susceptible of a fine polish, and is much used in chair-making and cabinet work, but is only moderately durable when exposed to the weather. Isolated specimens occur which have the peculiar grain known as "bird's-eye maple," so much prized as an ornamental wood. There is a variety known to the farmers as "black sugar maple," which differs somewhat from the ordinary form in botanical characters. When at maturity in the forest the rock maple attains a height of seventy or eighty feet, with a diameter of from two to four, but in the open land it is many-branched, with a rounded, or oblong head, and a short, stout trunk. Foliage brilliant yellow and orange, in autumn. This maple is one of the most ornamental and popular of deciduous shade-trees, matures in about one hundred years, but grows rapidly enough to be valuable for fuel, timber, and shade in twenty or thirty. Although this tree is entitled to a place in the first rank in economic forestry, it is too much neglected, and there are few attempts to replace the old sugar orchards preserved by the first settlers.

The seeds of this maple are readily collected and nearly all vegetate, so the planting is readily done. The seeds had better not be dried but immediately planted, and a very slight covering will suffice, yet I think about one inch deep gives the healthiest plants. They can easily be transplanted the second year, but a maple from seed has, in my experiments, reached the diameter of sixteen inches in fifteen years without transplanting. Constantly fertilizing with bone meal, land plaster and ashes, alternating, and sowing about 200 pounds to the acre, will very much facilitate the growth, and I find also increases the sweetness of the sap.

Acer rubrum, L.

Red or Scarlet Maple, but almost universally called "White Maple" by the farmers and lumbermen of Vermont. A good sized tree, universally distributed over the state, on moist soils, to two thousand feet altitude, and so plentiful as to be at once recognized as the most common of our maples. Wood far more durable than that of other maples, lasting a long time unless driven into the ground as posts or stakes. Not as hard as that of the preceding species, but takes a good polish, and is used for the same purposes. "Curled Maple," the variety with wavy grain, is derived from this species. It is of rapid growth, has a height of from forty to sixty feet, and, owing to the brilliant colors of the foliage in autumn and the red flowers in spring, is the most noticeable deciduous tree in our forests. Much of our sugar is made from it, and some maintain that it exceeds the sugar maple in flow and sweetness of sap. In the experiments conducted by Prof. Wm. Frear, at my place, under the direction of the U. S. Commission of Agriculture, the sugar averaged 4.48 per cent., while the sugar maple averaged 4.52, but it was more unstable, reaching some days 9.38 and some days falling to 2.71 per cent. From this it may be seen why there is such a variety of opinions among farmers. Last spring I tapped 700 white maples and ran the sap down in a Champion Evaporator, manufactured at Richford, Vt., and I found with same treatment the sugar darker than from the sugar maple. The sugar seemed to taste as well, however, but would color tea slightly and seemed finer grained. I think, however, with sufficient care to exclude all juice of the bark, the sugar would be as handsome as any. The tree matures in about one-half the time required by the sugar maple and lives about one-half as long. After a growth of twenty-five years, it is almost impossible to find a tree without more or less dead branches, especially if in cleared land. It never reaches the majestic size of the sugar maple. It can be easily propagated by seeds, same as other varieties.

Acer dasycarpum, Ehrh.

White, Soft, or River Maple. A tree sometimes sixty or seventy feet in height, and four or five feet in diameter, although usually not more than forty or fifty, with a diameter of twelve or eighteen inches. A graceful tree, with deeply cut leaves, ripening its fruit the earliest of any of the maples. With us it is closely confined to the banks of the larger streams, and therefore forms a small proportion of our forests. It has soft wood, is of very rapid growth, and is the maple so largely used to plant on the prairies west of the Mississippi. Does not produce as much sap as the two former varieties but is well worth tapping.

Acer Pennsylvanicum, L.

Striped Maple or Moosewood, and *Acer spicatum*, L., Mountain Maple, are large shrubs or small trees common to our highland woods, the latter especially abundant along the sides of mountain brooks. Both are valuable for ornamental planting, but of too small size to serve for anything else but fuel. The sap from this maple is much the sweetest of any, averaging about ten per cent. of sugar, but the tree is seldom in sufficient numbers to tap, as a business.

Acer spicatum.

Bastard Maple. This variety is common on hillsides where rocks are abundant, has winged fruit, but amounts to little more than a bush though it is quite abundant in some sections.

Robinia pseudacacia, L.

Common Locust. A valuable timber tree, with us naturalized from the South or West. It does best in moist, alluvial soils, but in this latitude it is so subject to the attacks of borers as to greatly injure its wood and make the tree so short-lived that it is not worth while to give it much attention as a forest tree, which is to be regretted, as the timber is hard, elastic and exceedingly durable. It is with us a middle-sized tree, but in the South it becomes sixty or eighty feet high, with a diameter of three feet. There is great vitality in the root and when the tree has been killed the roots will often send up a multitude of sprouts to take its place.

Prunus Americanum, Marshall.

In this state called Canada Plum or Pomegranate. A small tree, probably introduced from further westward for the sake of the red or orange-yellow fruit, which is sometimes very sweet and pleasant, but usually so acid as to be best adapted for preserving. It is now well naturalized in most parts of the state, especially in Essex county. This species is probably capable of great improvement as a fruit-tree, but as yet has been almost wholly neglected by the experimental fruit-grower.

Prunus Pennsylvanicum, L.

Red or Bird Cherry. A small tree, thirty or forty feet high, some times a foot in diameter. Everywhere common, but seldom large enough to be of any use except for fuel. It springs up most abundantly where woodlands have been wholly cleared away, and seems to be of use in shading the ground until more valuable trees can take root. Of late years the black knot has killed most of them, yet millions spring up in all highland sections where the timber has been removed and the fire runs over the ground. It is supposed by many that this tree is of spontaneous growth, as it is omnipresent, but the seeds have great capability of endurance and I presume will vegetate under favorable conditions after several hundred years.

Prunus Virginiana, L.

Choke Cherry. Is most common near streams up to one thousand feet altitude, and conspicuous for its handsome but very astringent fruit. Sometimes attains a height of twenty or thirty feet, and is large enough for firewood, but sprouts so vigorously as to be a pest where more valuable timber is desired.

Prunus pumila, L.

Dwarf Cherry. A low, trailing shrub on the sandy shores of the Connecticut and probably other of the larger streams. The abundant, handsome, dark-red fruit, is insipid and worthless.

Prunus serotina, Ehrh.

Black Cherry. A tree often sixty to eighty feet high, with a diameter of two to three feet, the hard, reddish-colored wood taking a high polish, and is yearly becoming more valuable for the making of fine furniture, finishing the interiors of houses, railroad cars, etc. It does not form extensive tracts of woodland by itself, but may be frequently met with among all species of deciduous trees and in a great variety of soil in all parts of the state below two thousand feet above the sea. The cherry grown in New England is harder to work than that from the Mississippi valley, but it is darker colored, and takes a much higher polish. As cherry lumber brings readily from thirty to sixty dollars per one thousand feet, and is of very rapid growth, it cannot fail to prove an excellent species for planting, the only objection being that it is the host of the tent caterpillar; but the danger to fruit trees from this source is probably exaggerated.

It seems probable from my experiments on its growth that a large profit can be realized by planting. The young trees are stronger if the stone is cleaned from the pulp before planting. They should be planted as near as six feet apart if you would get valuable results in timber, with good bodies to trees; then gradually thin out as occasion requires to one-half the number.

Spirea saticifolia, L.

Meadow Sweet, White Hardhack. Common. A showy plant, but of no utility. It may be killed by constant cropping, say three or four times each year.

Spirea tomentosa, L.

Red Hardhack, Steeple-bush. Has the same range as the preceding, but not usually so abundant. Flowers pink, showy.

Rubus odoratus, L.

Purple Flowering Raspberry, Mulberry. A handsome shrub, with large three to five-lobed leaves and large purple flowers. Grows in moist, rocky woods. Common to the northern parts of the state and the Connecticut valley. Fruit of no value, but the plant worthy of cultivation for ornament.

Rubus strigosus, Michx.

Wild Red Raspberry. Well known everywhere, but it is best developed in the mountain region and northward. It forms dense thickets in forest clearings, and the abundant fruit is picked and sold in town and city.

By mixing the fruit with a small quantity of Boracic acid it may be kept perfectly fresh for a long time.

Rubus occidentalis, L.

Black Raspberry, Thimbleberry. The black-cap raspberry of cultivation. It propagates itself from the tips of the long recurved shoots. It is more southern in its range than the preceding, and much less abundant.

Rubus villosus, Ait.

High Blackberry. Much more bushy than the two preceding, and freely armed with stout, recurved prickles. It varies in height from a few inches to five or six feet, and each kind of bush seems to represent a different variety of fruit. It is common in most places. The fruit abundant, most of it good quality, and much in demand. Like the red raspberry it flourishes best where woods have been cleared away. Does well under cultivation.

Rubus Canadensis, L.

Low Blackberry, Dew Berry. Connects with the smallest forms of the preceding. It is a low, extensively trailing, very bristly shrub, common to the upper terraces of the streams and dry hillsides. Fruit abundant and well flavored. Ripe earlier than the high blackberry.

Rubus hispidus, L.

Evergreen, Swamp Blackberry. Common to damp, highland woods. It has very slender, trailing stems, evergreen leaves, and small, spicy, sour fruit.

Rosa, L., Rose.

The rose genus in Vermont is represented by three native species.

Rosa Carolina, L. Swamp Rose, is the largest and is most abundant in the eastern part of the state, being sparingly found only in the lower Connecticut valley. It grows three or four feet high, forming thickets in swamps and low ground.

Rosa blanda, Ait. Smooth Rose. Grows in dry, sterile soils, and is usually only a few inches high. The earliest flowering species.

Rosa lucida, Ehrhart. Shining Rose. A slender, few-flowered species, with shining leaves. In moist, shady soils ; not very common.

Rosa rubiginosa, L. Sweet Briar. Naturalized from Europe, and is common in old pastures in many parts of the state.

Cratagus coccinea, L.

Scarlet Fruited Thorn. A low, bushy tree. Common. Fruit ovoid, a half an inch in diameter ; bright red.

Cratœgus Crus-galli, L.

Cockspur Thorn. Frequent throughout the state up to two thousand feet altitude. It is, however, most abundant on the highlands. Sometimes has a diameter of six inches, and a height of twenty-five feet. Fruit smaller and not so deep red as that of the preceding. The wood of the thorn is yellowish-white, very hard, and heavy ; takes a high polish, but is too difficult to work to be of much use. Both species are well adapted to hedge planting.

Pyrus arbulifolia, L.

Choke Berry. A slender shrub, common to moist grounds. The abundant flowers white or tinged with rose, and the handsome black or purple fruit so astringent as to be worthless.

Pyrus Americana, D. C.

American Mountain Ash. A small tree with pinnate leaves, and a bushy habit. It bears a profusion of white flowers, followed by the bright red fruit, and is well known as an ornamental tree. The common pear can be readily grafted into it, and flourishes well for a while. It is a highland tree, common to the Connecticut water-shed, and very abundant on the sides of mountains, where it sometimes becomes a foot in diameter and thirty feet high.

Amelanchier Canadensis, T. and G.

Shad-bush, Wild Sugar Plumb, or Service-berry. The first name given because it blossoms when the shad first begin to ascend the rivers. This species presents several well marked varieties, the largest of which, the *var Botrypium*, becomes a small tree, twenty or thirty feet high, and from six to ten inches in diameter; the wood solid, heavy, and susceptible of a good polish, but probably never used for anything except fuel. The variety *oblongifolia* bears the largest and best-flavored fruit, and is a tall shrub, growing in moist soils usually. In England the fruit of the shad-bush is said to much improve by cultivation, and doubtless something can be made of it by the pomologist.

Ribes Cynosbati, L.

Prickly-fruited Gooseberry. Common to the highlands, and the most widely distributed of our gooseberries. A shrub three or four feet high; the fruit well-flavored, but usually covered with spines.

Ribes hirtellum, Michx.

Smooth-fruited Gooseberry. Connecticut river valley. A smaller shrub than the preceding, with smooth, purple, sweet fruit. This species is worthy of cultivation, as those who have cultivated say it rivals many usual garden varieties.

Ribes lacustre, Poir.

A low, prostrate species, with much-divided leaves, and black, currant-like, insipid fruit. It is common in swamps in the north part of the state.

Ribes prostratum, L'Her.

Fetid Currant. Skunk Currant. A low, half-trailing shrub. The leaves, flowers and fruit give out an unpleasant odor, but the fruit is not unpleasant to the taste. It is common to moist highland woods.

Rebes Rubrum, L.

The Garden Currant is a native, or at least is found in all sections of the state. The currant worm and all other insects can be kept off by dusting the bushes with the following mixture, which is also good to kill cabbage worms or any other insect pest: 50 lbs. calcined plaster, 8 ounces white arsenic, 4 ounces London purple. Mix the arsenic and London purple until it is even color, and then mix with the plaster until the slight purple tinge is evenly distributed. This is not poison enough to injure man or beast, in any quantity they would get, and may be put anywhere in sufficient amount to kill worms without detriment or danger. The purple color is so prominent that its presence is revealed when there is the least quantity, and it readily washes off of any fruit.

Hamamelis Virginica.

Witch Hazel. A large shrub or small tree, everywhere common. It generally throws up several stems from the same root, which are sometimes three or four inches in diameter. Wood white, close grained, taking a good polish; useful for handles of small tools and excellent for fuel. Bark medicinal. Remarkable for flowering in autumn when the leaves are falling.

Cornus Florida, L.

Flowering Dogwood. The largest of the genus, being a tree sometimes twenty or thirty feet high, and six inches in diameter; branches grey, wood dense, heavy, very close grained, and taking a brilliant polish, and is said to be a good substitute for boxwood. The heads of flowers are surrounded by a large involucre, which makes it very showy. Fruit bright red. It is very ornamental, but is seldom seen in cultivation. In this state its range is limited to the south-eastern part, and very near to the Connecticut river.

Cornus circinata, L'Her.

Round leaved Dogwood. Moose-berry. Stems one or two inches in diameter; four or six feet high, with greenish warty-dotted branches. Leaves large, nearly round, and woolly beneath. Fruit light blue. Connecticut river valley; most common northward.

Cornus sericea, L.

Silky Cornel. Stems slender: few branched, striated with red and brown, one or two inches in diameter, and five to ten feet high. Common near streams up to one thousand feet altitude. Fruit pale blue, and leaves silky beneath.

Cornus stolonifera, Michx.

Red Osier Dogwood. Upper Connecticut valley and mountain region. A handsome species, forming large clumps by sending up an abundance of bright red, purple, osier like shoots, three to six feet high. It spreads freely by subterranean suckers. Fruit lead color.

Cornus paniculata, L'Her.

Panicled Cornel. Shrub four to six feet high, with grey branches. Grows on dry grounds, and ranges nearly with the flowering dogwood. Fruit white.

Cornus alternifolia, L.

Alternate-leaved Cornel, Dog-ackerme. Everywhere common in moist woods. Next to the flowering dogwood in size, being sometimes twenty feet high and four or five inches in diameter; branches wide spreading from near the top, giving it a flat head. Fruit blue. All the cornels are worthy of a place in a collection of ornamental shrubs, because both of the flowers and fruit.

Nyssa sylvatica, Marshall.

Hornbeam, Sour Gum, Pepperidge, or Tupelo. A tree sometimes sixty or seventy feet high, with a diameter of from eighteen inches to three feet, and stiff, angular branches. It usually grows in swamps, and in moist, low lands. It is most common in valleys, and is seldom seen in the north part of the state. Wood remarkable for its spiral grain, which renders it unwedgeable. It is seldom used, but if not too soft its non-splitting property would make it a good material for wagon-wheel hubs. It has been thought equal to holly as a cabinet wood by those who have experimented with it.

Lonicera parviflora, Lam.

Small Honeysuckle. A half-climbing shrub, with the smooth leaves joined together at the base, and greenish-yellow flowers. Found sparingly along the Connecticut and its largest tributaries.

Lonicera cilliata, Muhl.

Fly Honeysuckle. A straggling shrub three or four feet high, with pale yellow flowers and red fruit. Common in rocky highland woods and northward.

Lonicera cœrulea, L.

Mountain-Fly Honeysuckle. Common in moist grounds on the Connecticut water-shed, and in alpine ravines and northward. A half-trailing shrub, forming matted tufts. Flowers straw-color, and fruit blue.

Diervilla trifida, Mœnch.

Bush Honeysuckle. A low, upright shrub, with ovate, taper-pointed leaves, and honey-colored flowers. Fruit a dry capsule. Common everywhere in rocky places.

Sambucus Canadensis, L.

Common Elder. A shrub five to ten feet high, with soft-wooded stems, remarkable for the size of the pith they contain. It is everywhere common. Flowers white. Fruit juicy, black-purple, very abundant, and used to make a medicinal cordial.

Sambucus pubens, Michx.

Red-berried Elder. Grows larger and more tree-like than the preceding species, and is sometimes fifteen feet high, with a diameter of three or four inches; pith brown, and the flowers often purple tinged. Berries bright red, making the plant very showy. This is a highland species, common northward.

Viburnum Lentago, L.

Sweet Viburnum, or Sheep-berry. A large shrub or small tree, and seldom seen above six hundred feet altitude. The leaves are ovate, sharp pointed, thick and shining. Flowers white, as are those of all the Viburnums. Fruit in large bunches, bright blue, edible. Wood hard and heavy, brown; takes a fine polish.

Viburnum nudum, L.

Withe Rod. Stems slender, sometimes two inches in diameter, and six or eight feet high. Grows in clumps, and is everywhere common in wet lands. Fruit blue. Wood gives out a disagreeable odor when burned.

Vibuanum dentatum, L.

Arrow Wood. Leaves broad ovate, sharply toothed. Stems slender, very straight, with pale grey bark. Grows in large bunches, and found everywhere in bogs and very wet places. This species was used by the Indians for the shafts of arrows.

Viburnum acerifolium, L.

Maple-leaved Viburnum. A slender shrub, with three-lobed leaves. Common on the highlands among deciduous trees. Fruit red, turning purple when fully ripe.

Viburnum Opulus, L.

High Cranberry Bush. Shrub five to ten feet high, with light grey bark. Strongly three-lobed leaves, and bright red acid fruit, which is often used as a substitute for cranberries. The snow-ball tree of cultivation is derived from this species. Common.

Viburnum lantanoides, Michx.

Hobble Bush. A low, straggling shrub, the reclining branches often taking root. The leaves are broad ovate, heart-shaped, rusty-scurfy beneath, as are also the tips of the branches. Flowers handsome, in broad, flat cymes. Fruit at first dull red, then black. Common in moist woods everywhere, but especially so northward.

Viburnum pubescens, Pursh.

A shrub about six feet high. Flowers white. Rocky banks.

Viburnum panciflorum, Py.

A small shrub with white flowers. Mansfield mountain.

Cephalanthus occidentalis, L.

Button Bush. A coarse, smooth-leaved shrub, growing on the borders of ponds and slow streams in the lower Connecticut valley Flowers greenish-white, in globular heads.

Gaylussacia resinosa, T. & G.

Common Huckleberry. A slender, much-branched shrub, one to three feet high, forming a close undergrowth in dry pine woods, etc. Only sparingly found in the lower Connecticut valley, rarely reaching to elevations 1,000 feet above the sea on the southern highlands. Fruit usually black, sweet and pleasant, ripe in August, and extensively gathered and sold.

Vaccinium Oxycoccus, L.

Small Cranberry. A very slender, trailing shrub, with white, spotted berries the size of pease. Chiefly in peat-bogs.

Vaccinium Macrocarpon, Ait.

Large Cranberry. The well known species whose fruit is extensively sold in the markets. Trailing, like the preceding, but a larger plant. In peat-bogs and moist ground of all parts of the state.

Vaccinium Vitis-Idœa, L.

Cow Berry, Mountain Cranberry. A low, tufted and matted evergreen, common to the alpine Green Mountain region. Fruit small, red, abundant, resembling in flavor and used for the same purpose as cranberries.

Vaccinium uliginosum, L.

Bog Bilberry. A dwarf, tufted, alpine species, with black, sweet berries.

Vaccinium cœspitosum, Michx.

Same *habitat* as the preceding, growing in small tufts. Fruit large, excellent.

Vaccinium Pennsylvanicum, Lam.

Dwarf Blueberry, Low Blueberry. Six inches to two feet high, usually forming straggling masses in dry woods and old fields. Common, and well known throughout the southeastern parts of the state. Fruit abundant, blue or black. The earliest blueberry of the markets.

Vaccinium Canadense, Kalm.

Canada Blueberry. A straggling shrub, stouter than the preceding, which it resembles. Leaves and branches downy. Berries often oval, blue, somewhat acid. Probably never seen in the markets. Northern part of state.

Vaccinium vacillans, Solander.

Half-high Blueberry. Sugar Blueberry. Two or three feet high, with upright, slender, yellowish-green branches. Fruit harder, and keeps longer than that of any other species; usually very round, bright blue, and spicy. It has the most limited range of any of our blueberries. It is common on pine barrens, and sparingly found very near the Connecticut river as far north as the rapids at White River.

Vaccinium corymbosum, L.

High Blueberry. A shrub ten to fifteen feet high, with stems sometimes two inches in diameter. It grows in moist lands and swamps. The wood is hard and very close-grained, useful for the handles of small tools. No attempts have been made to cultivate it, although it doubtless could be cultivated to advantage.

Cassandra calyculata, Don.

Leather Leaf. A low, many-branched shrub, with brownish-green, leathery leaves, and one-sided racemes of small white flowers. Fruit a dry capsule. Forms dense masses in bogs, and along the shores of ponds.

Andromeda polifolia, L.

A handsome little evergreen shrub, rarely found, in peat-bogs. Flowers large, white or purple tinged. Leaves with revolute margin; white beneath.

Andromeda ligustrina, Muhl.

Male Blueberry, Stagger Bush. Shrub three or four feet high, with yellowish bark. In the same situations and much resembling the high blueberry, but the fruit a dry, globular pod instead of a berry. Sometimes poisonous to cattle. Southern parts of the state.

Kalmia latifolia, L.

Spoon-wood, Spoon-hunt, or Mountain Laurel. A much branched and contorted shrub, four to fifteen feet high, with broad, lance-shaped. evergreen leaves, and bearing a profusion of large white or rose-colored flowers, stems sometimes four inches in diameter. Wood hard, heavy, and close-grained. Grows in swamps and moist, rocky woods, and it is very ornamental, but makes an undergrowth very difficult to walk through.

Kalmia angustifolia, L.

Sheep Laurel, Lamb Kill. A slender shrub, with oblong, evergreen leaves, which are pale beneath, and bears a profusion of small, deep rose-colored flowers. Has the same range as the preceding, and is poisonous to sheep.

Kalmia glauca, Ait.

Pale Laurel. Stems slender, straggling, eight to ten inches high ; leaves oblong, white beneath ; flowers few, lilac-purple ; sub-alpine and in peat bogs ; rare.

Rhododendron maximum, L.

Great Laurel. A shrub eight to fifteen feet high, the broad, wedge shaped, evergreen leaves six to ten inches long. Stems two to four inches in diameter. Wood hard and fine grained. Flowers large and very showy ; rose color, turning white. Swamps. Local in this state at Groton pond.

Ledum latifolium, Ait.

Labrador Tea. A low, evergreen shrub, with white flowers, and the leaves brown, woolly beneath. Sub-alpine ; Mountain region, and rarely in cold bogs in other parts of the state.

Ilex verticillata, Gray.

Black Alder, Winter Berry. An upright, slender shrub, the abundant, bright red fruit growing close to the branches, and persistent long into the winter. Wet grounds. Everywhere common.

Ilex lœvigata, Gray.

Smooth Winter Berry. Similar in habit to the last, but the lanceolate leaves shining above, and the larger berries on short stems. Swamps and borders of ponds ; southern part of the state.

Nemopanthes Canadensis, D. C.

Mountain Holly. A many-branched shrub, six or eight feet high

Bark light grey. The showy, deep-red fruit on long, slender stems. Very abundant on the highlands and northward, but common to all parts of the state.

Fraxinus Americana, L.

White Ash. One of the most widely distributed and valuable of our forest trees, but nowhere occurring in large quantities. It grows in a great variety of soils, but attains its best development in a strong, rocky soil, along with beech, birch, and maples. Although its wood is not so heavy as that of the European ash it is superior to it in strength and elasticity, and endures exposure to the weather moderately well. It is so well known, and adapted to so many different uses, such as carriage making, the handles for agricultural implements, oars for boats, etc., that it is becoming scarce and more valuable each year. It is of such rapid growth that it is one of the best trees for planting, either for fuel or timber.

Fraxinus pubescens, Lam.

Red or Downy Ash. Alluvial soil in the Connecticut valley as far north as Bradford. A smaller tree than the white ash, which it much resembles. Not abundant enough to be of value.

Fraxinus sambucifolia, Lam.

Black or Brown Ash. A medium-sized tree, common to swamps and wet lands throughout the state. The old growth yields lumber much used for interior finishing and cabinet work. The easily separated layers of the young trees are very tough, and used for coarse baskets and hoops, bands for bailing hay, etc. The wood is hard, and considered good for fuel, but not very durable when exposed to the weather.

Platanus occidentalis, L.

Buttonwood, Sycamore, or Western Plane-tree. Occurs in the Connecticut valley. Generally found very near the streams and much more abundant formerly than now, as this species, although vigorous enough in the Mississippi valley, seems as if falling into decay and gradually disappearing from New England. It is a large and handsome tree. The outer bark flakes off in large scales and shows the white inner bark, thus giving the surface a peculiar mottled appearance. The wood is moderately hard, said to be of value for cabinet work, but does not bear exposure to the weather. It is easily cultivated and bears the dust and smoke of cities better than most trees. Is a rapid grower in proper soil.

Sassafras officinale, Nees.

Sassafras. A tree usually twenty or thirty feet high. Branches irregular. Leaves dark green, entire or lobed. Flowers greenish-yellow, and the fruit blue. Along the Connecticut valley to Bellows Falls. Wood aromatic, durable, but not usually large enough to be of much use; the bark aromatic and medicinal.

Lindera Benzoin, Meisner.

Fever-bush, Spice-bush. A slender shrub, four to six feet high, with ash-grey bark. Leaves oval, dark green. Fruit red. Whole plant aromatic. It has the same range as the sassafras.

Dirca palustris, L.

Leatherwood, Wicopy, or Moosewood. A stout, much-branched shrub, with yellowish bark, the yellow flowers appearing before the leaves. Bark exceedingly tough and employed by the Indians for thongs. Grows on rich, moist hillsides, and is sometimes cultivated for ornament. Connecticut river valley and near Burlington.

Ulmus Americana, Willd.

White Weeping or American Elm. One of the largest and most imposing of our forest trees, never forming groves by itself, yet common in all parts of the state. The finest specimens grow in the rich alluvium of the river valleys. It has been more largely planted along the streets of the cities and villages than any other tree. The wood is light, strong and tough, with the fibres interlaced; difficult to season without warping, yet it is much used for the hubs of carriage wheels, the wood for brushes, ox-yokes, etc. It is a very heavy feeder, and consequently of rapid growth, and its ashes are said to yield more potash than those of other trees.

Ulmus racemosa, Thomas.

Cork Elm. Rare; occurs in damp soil. It is common from western New York to the Mississippi.

Ulmus fulva, Michx.

Red or Slippery Elm. Valley of the Connecticut, usually disappearing within ten miles of the river. Ranges as far north as St. Johnsbury. A middle-sized tree. Heart wood reddish, heavy and durable; the mucilaginous inner bark well known in medicine. This species does not occur in quantities large enough to be of practical value.

Celtis occidentalis, L.

Hackberry. A medium-sized tree, resembling the elm, which occurs sparingly along the Connecticut as far north as Wells River. This species develops into several botanically interesting varieties, and is common along the streams of the Middle states and the Mississippi valley.

Juglans cinerea, L.

Oilnut or Butternut. A very valuable tree, both for its timber and nuts. When grown in the forest, it is from two to three feet in diameter and sixty feet high, but in open land develops a short trunk and heavy, wide-spreading top. It prefers the alluvial soil of the river valleys, or fertile, moist hillsides, and is common throughout the Connecticut valley and along its tributaries. It is one of our best trees for timber culture, but such a gross feeder that it should not be planted near cultivated fields.

Carya alba, Nutt.

Shagbark Hickory. The largest and most valuable of our hickories. In the eastern part of the state it ranges in the Connecticut valley to White river and up that stream and common near Lake Champlain. Never found naturally very far from the alluvium of the streams, but will grow in almost any well-drained soil when planted. The nuts are readily sold at from two to four dollars per bushel, and give a considerable revenue to some of the farmers. The wood is considered the standard fuel, and first-class for carriage work and tool handles of various kinds. It should be largely planted, and the work not left wholly for the squirrels to do, as is now the case.

Carya porcina, Nutt.

Pig Walnut or White Hickory. A much smaller tree than the preceding, seldom being more than eighteen or twenty inches in diameter, but in the forest it grows tall and slender. Wood very valuable for axe handles, wagon thills, spokes, hoops for cooperage, etc. Nuts sweet and edible, but not equal to those of the shagbark. It is common in the Connecticut valley and is abundant on the hills near the river in the vicinity of the state line, but disappears with the foregoing species as one goes north.

Carya tomentosa, Nutt.

Mocker Nut or Black Hickory, common in the South and West. In Vermont it is found sparingly. The quality of the wood resembles that of *C. porcina*, but the tree becomes larger.

Carya amara, Nutt.

Bitter Hickory, called also Pig Walnut. A tall, slender, very smooth-barked species, worthless except for fuel, as the wood is brittle and free grained. Interesting botanically because it finds its eastern limit in the Connecticut valley, where it ranges further north than any other of our hickories, the limit being at Wells River. Fruit very thin-shelled and the kernel intensely bitter. It prefers a moist, fertile soil, and at the West, where it is common, it is called Swamp hickory.

Quercus alba, L.

White Oak. The most valuable of our oaks. Seldom seen at elevations much above six or seven hundred feet above the sea. It grows to a large size, and Vermont white oak in quality is unequalled by any grown in the United States. It is put to a greater variety of uses that require strength, hardness and elasticity, than any wood we have. Very little of the old growth formerly in demand for ship-building is left. This species prefers a strong, well-driained soil, and grows from the acorns much faster than is generally supposed, and should be fostered as much as possible. In the Connecticut valley it is confined to the hills in the immediate vicinity of the river, extending up the tributary streams a short distance, and disappears entirely before reaching the mouth of the Passumpsic.

Quercus bicolor, Willd.

Swamp White Oak. A large-sized, very rough-barked, valuable species, growing in low, moist ground. Not common.

Quercus Prinus, L.

Rock Chestnut Oak, Mountain Oak. A medium-sized tree. The wood strong and durable, and considered excellent for railroad sleepers. Occurs in belts or patches in the eastern part of the state. In the Connecticut valley it barely reaches our limits, on the hills of the south part of Brattleboro.

Quercus ilicifolia, Wang.

Barren or Scrub Oak. Has the same range as the last, and also appears along the lower Connecticut. A much branched and contorted shrub, six to fifteen feet high, forming dense thickets; very difficult to eradicate, and impeding the growth of better timber.

Quercus tinctoria, Bartram.

Black or Yellow Oak. A large species; only seen within three or four miles of the Connecticut river. The wood is elastic, strong, free-splitting and durable, the bark very rich in tannin, and gives a yellow dye. This species is not valued as its merits deserve, for it would serve equally as well as white oak for many purposes.

Quercus coccinea, Wang.

Scarlet Oak. Varieties, tinctoria Gray (black oak), and ambigua Gray (gray oak). While all are occasionally seen they are scarce, and not as valuable as other branches of the family.

Quercus macrocarpa, Mx.

Burr Oak and Q. prinoides, Willd, are found in the state, but not common; also Q. Muhlenbergia, Engl. is found on Gardner's island, Lake Champlain, Pringle.

Quercus rubra, L.

Red Oak. The most widely distributed and largest of our oaks. Very common in all parts of the state up to 1,500 feet above the sea, and only disappears in the far north. The timber is not nearly so heavy as that of our other species, but, from the freedom with which it could be split and worked, the old growth has been mostly cut. Red Oak grows much more rapidly than the other kinds, and attains a diameter of four or five feet, with a height of seventy or eighty. The younger growth is now much used for the bent work in chair manufacture. It can be cultivated with great advantage.

Fagus ferruginea, Ait.

Beech. This is essentially a highland tree, and does not become common until an altitude of 500 feet above the sea is reached. It is a common tree on the Connecticut water-shed, and enters largely into the composition of the hard wood forests of Essex county. In the south part of the state the best of it has been cut and used for chair stock, bucket hoops, etc. As it depends upon the seed alone for its propagation, it does not hold its own well in company with other trees, but is considered a valuable tree to grow. Wood dense and heavy; not very liable to warp, but easily perishable when exposed to the weather. It cannot well be transplanted if of any size, but can be readily planted where you desire it to grow.

Castanea vulgaris, Lam, *var. Americana*, A.

Chestnut. This well known and very valuable tree has a rather limited range in this state, but grows in the southern part near the Connecticut river as far north as Windsor. The large timber has long ago been cut, but it is of such rapid growth that it yields large quantities of railroad ties in short periods of time. The wood is very durable when exposed to the weather, and has been much employed in fencing. It is much used as a cabinet wood, and for interior work of houses, building-timber, etc., and its planting should be encouraged wherever it will grow. It flourishes best in strong, well drained soil.

Corylus Americana, Watt.

Common Wild Hazel. A slender shrub, forming dense thickets, mostly in the river valleys and southern exposures on the hillsides. Stems sometimes two inches in diameter, eight to fifteen feet high. Nuts edible; smaller than the English filbert, which they resemble; enclosed in a leathery, rounded involucre. The squirrels get the bulk of the fruit. Possibly it might be improved so as to rival its English cousin.

Corylus rostrata, Ait.

Beaked Hazel. A smaller species than the preceding. Common northward, in rich woods. Fruit enclosed in a long, beaked involucre, and in size and quality closely resembling the preceding species.

Ostrya Virginica, Willd.

Hop Hornbeam, Iron Wood, Lever Wood. A slender tree, with light-colored bark, brown-tipped branches, and birch-like leaves. Fruit enclosed in inflated sacs, which resemble those of the hop. Seldom more than forty feet high, with a diameter of a foot or eighteen inches. Wood white, very hard and stiff. Occurs in all parts of the state, but most abundantly along the highlands and northward.

Carpinus Americana, Michx.

American Hornbeam, Blue or River Beech. A large shrub or low tree, with wide-spreading branches, and blue-gray, fluted trunk. Wood hard, white and heavy, but too small to be of much service. Grows throughout the state, near the larger streams.

Myrica Gale, L.

Sweet Gale. Shrub two or three feet high, growing along the borders of ponds and in wet places; Found chiefly south of the White Mountains. Leaves aromatic.

Comptonia asplenifolia, Ait.

Sweet Fern. A low, bushy shrub, with sweet-scented, fern-like leaves. Grows best in dry, sterile situation. Ranges with the white oak in the Connecticut valley.

Betula lenta, L.

Black Birch. A tree sometimes two to four feet in diameter, but usually not more than eighteen inches or two feet. Bark dark colored, scaling from the trunk when old; heart wood reddish—this species is therefore sometimes called Cherry or Mahogany Birch. The wood is heavier than that of the other birches, and takes the best polish, is much used in turning and cabinet-work, and makes a superior fuel.

Betula lutea, Michx.

Yellow Birch. The largest of our birches, often being three or four feet in diameter, and sixty or seventy feet high. The bark of the young tree is yellow, whence comes the common name. It grows in all parts of the state, but is most abundant in places which are more than 500 feet above the sea level. The wood is nearly as valuable as that of the preceding species, which it much resembles in grain and density. It is much used in chair manufacture, and like all species of birch yields superior charcoal.

Betula papyrifera, Marshall.

White Birch, Canoe Birch. This species is found in all parts of the state. It is the most common on the highlands. It is conspicuous because of its very white bark, which was used by the Indians for making their canoes; and as it is easily separated into thin layers, it can be used for a variety of purposes, like the making of baskets, temporary pots for transplanting young plants, writing upon, etc. This tree is sometimes two or three feet in diameter, and sixty or seventy feet high; the wood moderately hard, yet capable of a good polish, and much used for spools, bobbins, chair work, boxes, etc., and when properly cured makes a good fuel, but very easily decays upon exposure to the weather. Being of very rapid growth, it is of value for quickly reforesting lands, and preparing for a growth of oak, or other slow-growing trees.

Betula alba, L., *var. populifolia*, Spach.

Poplar leaved, White or Grey Birch. A slender tree of small diameter, and dingy white bark. Most common in eastern part of the state. Wood useful as fuel in the vicinity of the large villages, but back from such markets it is of more value as a material for making charcoal, for which it is excellent. The young shoots are much used for hoops, in the making of fish barrels, nail kegs, and other coarse cooperage. As it is very easily grown from the seed, and succeeds well in the most sterile soils, it could probably be used for a nurse in the starting of pine and other trees, which will not grow in such places without some protection when first sown.

Betula pumila, L.

Low Birch. Shrubby; two to eight feet high. Rare.

Betula glandulosa, Michx.

Dwarf Birch. A slender, half-trailing species, confined to the alpine region of Green Mountains.

Alnus viridis, D. C.

Green or Mountain Alder. A stout shrub, with bright green colored branches. Forms dense thickets in the ravines, and occurs sparingly throughout the state.

Alnus incana, Willd.

Common or speckled Alder. A tall shrub, with stems one to four inches in diameter, and having few branches. Well known as forming thickets along all of the smaller streams, and in swampy places. Wood soft, of some use for fuel, and the charcoal made of it sometimes used in the manufacture of gunpowder.

Alnus serrulata, Ait.

Common Alder. This is the usual species and found almost everywhere through the length and breadth of the state. An excellent fuel and good for charcoal but grows so small that it is quite useless.

Salix candida, Willd.

Hoary Willow. Shrub six to eight feet high, with narrow, lance-shaped leaves, downy above, and white woolly beneath. In bogs.

Salix humilis, Marshall.

Prairie Willow. Usually three or four feet high, with wedge-oblong downy or woolly leaves. Runs into many varieties, and is the common dwarf willow of dry hillsides and barren plains.

Salix discolor, Muhl.

Pussy Willow. Glaucous Willow. Tree like, ten to fifteen feet high, large enough for fuel. Low grounds and moist hillsides. Flowers golden. Among the earliest of the willows.

Salix sericea, Marshall.

Silky Willow. A slender species, forming upright clumps five or six feet high, in the vicinity of streams; leaves very narrow, smooth above, fine silky beneath. Flowers greenish.

Salix cordata, Muhl.

Heart-leaved Willow. Stems five or six feet long; inclined, or half-trailing; leaves narrow, heart-shaped at the base. The most common willow along the sand-bars and banks of the larger streams.

Salix livida, Wahl, *var. occidentalis*.

Livid Willow. Ten or fifteen feet high; usually with a short trunk and a much-branched top. Leaves very veiny, and livid when first expanding in spring. Common throughout the highlands. Prefers rather dry soil.

Salix chlorophylla, Anders.

Green Willow. Alpine ravines of the Mountains; rare, and little known.

Salix lucida, Muhl.

Shining Willow. A very handsome species; rather common near streams. Usually ten or fifteen feet high, with broad, ovate, taper-pointed, shining leaves. Worthy of culture for ornament.

Salix nigra, Marsh.

Black Willow. The only one of our native species which rises to the dignity of a tree. This one is often forty feet high, and a foot in diameter. It confines itself very closely to the borders of the larger streams. The leaves are very long and narrow, taper pointed.

Salix alba, L.

White Willow. This species, which often becomes a tree three or or four feet in diameter, was introduced from Europe, and has become well naturalized throughout most parts of the state. The wood is light, strong, durable, and useful for many purposes. This species is the one so extensively planted in the Western states for wind-breaks, fencing, and fuel. With us it is better than any other tree to plant along river banks where they are in danger of being undermined by freshets.

Salix longifolia, Muhl.

Long-leaved willow. A common Western species, which finds its eastern limit along the Connecticut river, occurring from Westminster to the Massachusetts line. The slender shoots are better than any other American species for basket-work.

Salix Babylonica, Tourn.

Naturalized by cultivation.

Salix Balsamifera, Pringle.

Mt. Mansfield.

Salix fragilis, L.

Escaped from cultivation, for osiers.

Salix myrtelloedes, L.

Swamps.

Salix petiolaris, Sm.

Charlotte.

Populus tremuloides, Michx.

American Aspen. Called Quaking Asp in the Rocky Mountains. The most widely distributed of our poplars, being found in all parts of the state, up to 3,000 feet altitude, and in all varieties of soils except deep swamps. Usually a small tree ten to eighteen inches in diameter and forty to sixty feet high. Springs up oftentimes in great abundance where woodlands have been entirely cleared. The wood, when seasoned under cover, makes excellent fuel, but it easily decays when exposed to the weather. This species until recently was considered nearly worthless, but has now become of considerable value for the manufacture of pulp for paper.

Populus grandidenta, Michx.

Large toothed Aspen, or Black Poplar. Ranges nearly with the last mentioned species, but most abundant within the altitude of 500 and 2,000 feet above the sea. A tree much larger than the Quaking Asp, being sixty to eighty feet high and two feet in diameter. Wood very white, of light weight and strong; good for furniture, interior work and for paper-making.

Populus balsamifera, L.

Balsam Poplar; both it and the variety *candicans* are also called Balm of Gilead. A large species. With us it is native of the Connecticut valley, generally near the river, becoming more plentiful northward. The variety *candicans* is rarely found in a wild state, but is the form commonly planted, and botanically seems to be a transition between this and the next species. This poplar is a very rapid grower and makes large timber. The wood is very soft, tough-grained, and easily decays. It spreads so rapidly by shoots from the roots as to become a pest where the land is at all valuable, but it could be often employed in waste lands where a quick-growing tree is desirable for fuel.

Populus monilifera, Ait.

Necklace Poplar. This and the preceding species is known through the West as "Cottonwood." It barely comes within our limits in the western part of the state, being in the eastern confined to the immediate vicinity of the Connecticut river, and disappears near the north part of Windsor. It is a large, handsome tree, and probably would be equal to the other poplars for paper-making.

Popular dilitata, Ait.

Lombardy Poplar. Quite common and yet a naturalized foreign species. If taken care of it is a tall stately tree of rapid growth and short life. The branches are so close and so near perpendicular that they are apt to split from freezing. If neglected the leaves accumulate between the limbs and trunk, and hold water and snow so that with freezing the expansion starts the limbs from the trees and the limbs die. They were once very popular as shade trees.

Popula alba, L.

Silver Poplar. Common.

Popula angulata, Ait. Not common.

Pinus strobus, L.

White Pine. The largest, most useful, and having the greatest range of distribution of our conifers, being everywhere common, from the sea to 2,500 feet altitude.

Formerly large forests of this species were common, but these magnficent woods have long since disappeared, but a few scattered remnants remaining. Specimens have been known which were more than two hundred feet high and six or eight feet in diameter. The white pine seeds very freely, and the site of the ancient forest is indicated by tracts of vigorous saplings which in twenty or thirty years are fit to cut for pail and fish-barrel staves, laths, clapboards, box boards, etc., and in sixty years yield good timber and boards. Springing up as it does on so many worn-out and abandoned farms, the white pine has made industry and wealth possible to many parts of the state which otherwise would have been wholly deserted. As it is our most useful evergreen, so it is the easiest to cultivate and also to spring up naturally, or it could not hold its own so well against the constant cutting to which it is subjected, and in any scheme of forest culture in our state it must hold the foremost place.

Trees of this kind under my own cultivation have reached a diameter of seventeen inches in twenty-five years, and I believe that the attention of all having waste places of good pine land should be urged to plant the certainly profitable crop of pines. There is much to contemplate that is curious about those trees. They were formerly called the wheel pine because as they grow up towards the sky, every foot or two they shoot out five spokes, or lateral branches, and these branches keep doing the same, or nearly the same, as they start off horizontally, and then curve upward. You will know this particular family from all the pine families by their strong predilection for the number *five*. Their perpendicular leader has not always, but almost always, exactly five spokes in his wheel. His followers may have fewer, but always five if they can. Between the youngest hubs, both the leaders and the followers put forth budlets, or leaf buds, each producing exactly five leaves, or green needles. These budlets are so disposed around the stem, spirally, that if you sever the stem above and below any consecutive five, the five groups, of five needles each, will shoot into the air in five different directions, generally seventy-two degrees apart. This is a wonderfully good arrangement for catching all the particles of tree-food floating in the air—something like that of a whale's mouth, by which that huge animal is said to live on minute animals floating in the water. This arrangement accounts for the family's wonderful tenacity of life. Wherever their roots can grapple a foothold among the New England rocks, as well as in her plains of sterile sand, they flourish in personniel green. Breathe balsam into the lungs of the sick, make strong men stronger, hoard up pure springs for the thirsty, defy drought, beyond all other trees and temper the blasts of winter and the heat of summer. In fine they were formerly the beautiful giants of the

Vermont forests. And their return would be a blessing in many ways. Why should not the state offer premiums on second growth pine groves?

Pinus rigida, Miller.

Pitch Pine. This tree when fully grown, is from fifty to seventy feet high and two feet in diameter, with heavy, very resinous wood, which is well suited for flooring and building timber; but the old growth, which accords with this description, has nearly disappeared, and the second growth is short and scrubby, better adapted for fuel than anything else. The wood also makes good charcoal. It is to be met with, where the soil is favorable, in the southern highlands up to 1,000 feet above the sea, and along the Connecticut to the mouth of the Passumpsic.

Pinus resinosa, Ait.

Red Pine, also very commonly called Norway Pine, a name which is erroneous, as this tree is not a native of Europe. The botanical name also is a bad one, as the wood is not specially resinous. It is a very handsome species, growing from sixty to eighty feet high, holding well its diameter, and makes excellent building timber and floor boards. It ranges with pitch pine, but is less common, being usually in groves of from a few acres to several hundreds in extent. It will grow well in the sterile soil preferred by the pitch pine, and as it is so much more valuable as a timber tree, it is preferable for planting in such places. During the first twenty years of growth it attains a larger diameter than either the white or pitch pine.

Picea Banksiana, Lam.

Gray Pine. Scarce.

Picea Mitis.

Yellow Pine. Not common.

Picea nigra, Link.

Black Spruce. Next to the white pine; the most important evergreen of the state. It takes today the lead in numbers in all the lumber regions of the country where spruce is desired. The wood is light, elastic and strong; valuable for a great variety of uses, both for inside and outside work, paper pulp, etc. In the Green Mountain region and northward it grows very rapidly, but on the southern highlands where the old growth has been mostly removed, the younger does not seem to start quickly, and the timber is coarse and knotty.

Picea alba, Link.

White Spruce. A Canadian species, abundant around the sources of the Connecticut, disappearing at the Fifteen-mile Falls on that river. It is a medium sized tree, the wood similar to that of the black spruce, but the tree more symmetrical in outline, with light colored bark, and a bluish-green appearance of the leaves.

Abies balsamea, Marshall.

Balsam Fir. Ranges with the black spruce, and equally common with it. It is the most symmetrical of the evergreens; sometimes attains two feet in diameter; is short lived, and until recently considered worthless, but is now considered to be good for boards and shingles, which bear exposure to the weather as well as the hemlock. The trunk is covered with large blisters, which yield the Canada balsam employed in medicine and microscopy. It is a rapid growing tree and easily cultivated. With my culture it attains fourteen inches diameter in twenty-five years.

Tsuga Canadensis, Carriere.

Hemlock. The most widely distributed of our evergreens, ranging from the sea to 2,000 feet altitude in the mountains, but sparse in some sections of the state. A large tree, and when young the most graceful of our conifers; well adapted for ornamental planting. Its bark is so much sought after for tanning leather, and the wood for boards, shingles and building timber, that the old growth is mostly gone. It does not seed as freely as the pines, but with a little care and protection can be very easily grown, and a tract of hemlock forest would probably yield a revenue next to that of white pine.

Larix Americana, Michx.

American Larch, Hackmatack, Tamarack. The only deciduous leaved conifer found in north eastern United States. A tall, slender tree, preferring cold, highland swamps. It is quite abundant in some sections, but in others hardly ever seen. The roots strike out at right angles from the trunk, generally three or four very large ones. The tree is dug up, and four or six feet of the trunk taken off with the roots, to be sawn up into the "knees" used in shipbuilding. The timber is hard, very heavy, and durable when exposed to the weather. Probably inferior to the European larch, but would be a good tree to grow upon lands that cannot be easily drained.

Thuya occidentalis, L.

Arbor Vitæ, or White Cedar. This is also abundant in some sections and very sparse in others. It has light, soft, very durable wood, excellent for shingles, fencing, telegraph poles, etc. It sometimes attains a diameter of three feet, but not usually more than eighteen or twenty inches, and a height of fifty or sixty feet. It is much used to plant for evergreen hedges, and in this form is common in all towns and villages.

Juniperus Virginiana, L.

Red Cedar. A small tree, growing in dry, sterile soil. It is most frequent in the south east part of the state. Appears in the Connecticut valley sparingly and about Lake Champlain. Wood very durable, and valuable for fuel and fencing, and the handsome, deep red heart-wood for ornamental purposes. It has the slowest growth of any of our conifers.

Juniperus communis, L.

Savin. A prostrate, wide-spreading shrub, which sometimes overruns worn-out lands. Has the same range as the red cedar.

Taxus baccata, var. *Canadensis*, L.

Canadian Yew, or Ground Hemlock. Much like the savin in habit, has brownish-green leaves, and the fruit becoming fleshy resembles a red berry. Grows in cold, deep woods throughout the state.

HOW TO OBTAIN SEEDS.

If after the study of forestry and the species any should desire to plant, as I trust they may, there will come a question, how to obtain seeds. The Forestry Commission of New Hampshire have answered that very well, and I quote from them.

There will be no trouble in obtaining seeds of the oaks, walnut, hickory, beech and chestnut, but of some other species they are not equally accessible. The elm and maples sometimes ripen their seeds in such profusion as to cover the ground. How best to secure them is a conundrum that we leave others to solve. There is the same difficulty in obtaining seeds of evergreens, as they shed their seeds in the fall as soon as the frost lifts the scales of their cones. If the cones could be gathered before being opened by frost they would give us an abundant supply of seeds; but unfortunately they are beyond our reach. Seeds of the pines can sometimes be obtained when timber is being cut in the nick of time.

We have often seen the ground so covered with the pill-like seeds of the European linden that, if sugar-coated, the dealer in patent medicine might make them available in his business. Fortunately there are persons who know how to secure all the different seeds required, and there are dealers who make a specialty of supplying them in large or small quantities. Forest tree seeds can be ordered of almost any seedsman, who will furnish them, if not in stock, with very little delay, and at reasonable prices. There is always more or less uncertainty about their quality, as there is no general demand for them, and they are liable to become so venerable with age as to lose their vitality.*

The best time for gathering all seeds of forest trees is as soon as they are ripe, and unless they are planted at once they must be carefully preserved. There is no better way in which to keep the seeds of conifers than in the package nature has provided for them. Some of the small seeds may be kept in the ordinary seed-bags of cloth or paper, and if stored in a cool, dry place, they will retain their vitality for several months, possibly for years.

But dried seeds start slowly; many never grow, and others remain in the ground one, two, and even three years before germination. For this reason it is better to mix seeds with damp—not wet—sand as soon as gathered, especially if the sowing is to be deferred till spring. They may be put in boxes having holes in the bottom to ensure drainage, and the whole buried in the ground during winter. The seeds may be separated from the sand in spring by screening, or they may be sown together in shallow drills, as elsewhere directed.

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*Mr. Thomas Meehan, of Philadelphia, has a full line of tree seeds, catalogues of which may easily be obtained. He is regarded as a very intelligent and reliable man.

The large seeds, such as the hickory and the oak, must never become dry, neither should they be kept wet and warm. They require exposure to frost, which opens their shells and allows the germ and radicle to escape at the proper season.

Spreading nuts and pits upon the ground as soon as gathered, and covering lightly with sand or with boards to prevent the depredations of squirrels, will carry them through the winter in a perfect condition. The shells, having been kept moist and acted upon by frost, will be found so loose as to be easily removed with the fingers; but if any are still inclined to adhere, a slight tap with the hammer will be required.

The seeds of the chestnut, beech, and some others are covered by a thin and not very hard shell; and if the nuts are planted where they are to grow or in nursery rows before becoming dry, they will germinate with no further trouble.

NECESSARY PROTECTION.

In this respect law can aid, and there is need of the law becoming more definite and stringent. The laws in force upon this subject are as follows:

Revised Laws, Sec. 4200. A person who carelessly and without malice injures or defaces a building belonging to a town or county in any manner, or injures shade trees or shrubbery connected with such building, or fastens a horse or other animal to the fence, posts or trees about such buildings, shall forfeit to the state not less than two dollars with full costs.

Sec. 4211. Whoever trespasses upon any fair ground of any state, county, town, or other incorporated agricultural society or fair, by climbing over or breaking through any fence or enclosure thereof, or committing any depredations by cutting or destroying any timber, tree or water-pipe within such enclosure, or breaking or carrying away any property owned or controlled by such society or fair, shall be fined not less than five, nor more than one hundred dollars, and shall be liable civilly for all damages sustained by such wrongful act.

Acts of 1884, No. 20. A town may, at a legal meeting, the warning for which contains an article for that purpose, direct the treasurer to pay to the selectmen a sum not exceeding one per cent of its grand list of the preceding year, to be expended by them in premiums or in any other manner that they may deem most effectual, to encourage the planting of shade trees upon the public squares, parks or highways, by the owners of adjoining real estate.

No. 22. A person who wilfully injures or destroys a shade or ornamental tree standing in a public highway, park or common, burial ground or cemetery, or a tree standing in a highway, in a dangerous place, which does, or will, when grown, protect travelers from harm, shall be fined not more than fifty nor less than five dollars. But this section shall not prevent the selectmen or the proper authorities of a village from removing such trees, when, in their judgment, the public good and convenience requires.

It will be readily seen that something is needed for forests. The great bane of natural growth is fire, and those fires are largely careless fires from clearing, or from fires set on cultivated land by boys hunting or by camping out in the vicinity of mountains, lakes or ponds. Certainly protection should be given, and such protection as will prevent worthless people as well as men who can pay fines from setting careless fires. More ample protection for shade trees and trees cultivated for fruits and also shrubs, is needed.

I would also suggest laws offering premiums for the setting out or planting of forest areas so much per acre or otherwise as would seem best. But there is wisdom in our legislatures, and it is said that a word to the wise is sufficient.

CONCLUSION.

I have thus endeavored to show, by undoubted authorities, the great rapidity with which our forests are disappearing, the vast demand upon them for domestic and manufacturing purposes, the near approach of the time when our home supply will fail, and the immediate necessity of instituting means for the protection and replanting of the forests in our state. Their beneficent influence upon the climate and healthfulness of the country, upon agriculture, and upon the general prosperity of the people, I have shown, I think, by unquestionable evidence. With these facts before us, our duty is plain. We must agitate these facts until they are understood and appreciated—until the representatives of the people of the State of Vermont shall give us wise laws on the subject of forestry, and thereby aid in redeeming the waste places, and rendering them once more productive in valuable wood and timber; until the farmers and fruit-growers shall understand that a larger proportion of woodland than they now have in this state will greatly enhance their productions and enable them to calculate more surely upon the annual crop; until the beauty of trees in the landscape shall enhance the pleasures of life and minister to the higher æsthetic nature of the people.

Love for trees is a beautiful sentiment to instill in the hearts of the young, and it is the sure stepping-stone to that knowledge and appreciation of the beauty and usefulness of trees and forests that will lead them to plant, to protect and to nurture *trees*—"God's first temples."

THE MAPLE SUGAR INDUSTRY.

The manufacture of maple sugar is of special interest to Vermont as a state, as according to the size of the territory it is the most productive of any equal area in the maple sugar belt of America. The amount manufactured according to the census of 1880 was 11,261,077 pounds of sugar and 128,091 gallons of molasses; the sale of the product brought a sufficient amount of money to average at least three dollars a head to every man, woman and child in the state. It is manufactured at a time when other work on the farm is not driving, and as a whole is profitable. Different manufacturers estimate the cost of making the same at from three to eight cents per pound, the difference mainly being due to the worth of wood used in boiling the sap.

TAPPING.

Experiments in this line have been numerous. I have in experimenting been through with some thirty different processes, by axe and gauge, by various devices of cutting and boring, also with all the various kinds of spouts I have heard of, and the result is that the following facts seem to be established:

First. The sweetest and best sap comes from the previous year's growth, and any spout that cuts off any of the sap from this grain is not a desirable one.

Second. Any spout or device that allows the hole to dry up or season by the effect of evaporation, is not as desirable as one that does not.

Third. The smoother and more perfect the cut, the better the sap flow.

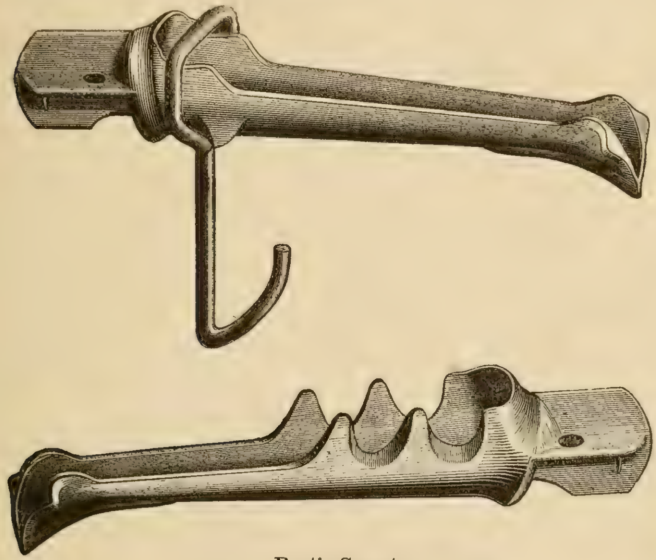
Fourth. The nearer the ground the tree can be consistently, tapped the larger the amount of sugar.

TAPPING INSTRUMENTS.

Of all I have tested the oval-lipped bit, with a small screw, one-half inch in diameter, I deem best for the purpose. As the nail to hang a bucket on kills the trees by the leakage of sap around them that sours on the trees, more than the bit, I would never drive one, but would set the bucket on the ground or hang it on the spout.

SAP SPOUT.

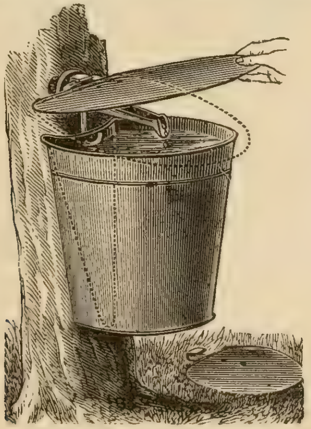
It may be expected that I will name the spout showing the best behavior under critical experiment. I believe the Post spout, so called, manufactured by C. C. Post of Burlington, as now improved, is the best yet invented. It is now made of a combination metal that will not rust or corrode. The sap is retained in the hole in which the spout is driven so it cannot be dried as it otherwise would. The bucket, whether wood or tin, can be hung on the spout, and with the notched spout any bucket can be hung, so the wood covers described further on can be used. It does not close the pores of the last year's growth of sap wood; yet if properly driven it never leaks. When the spout is removed, however, the hole must be plugged, as if not the sap will start more or less and become sour on the bark; and this acidity will kill a large place upon the tree. Many have condemned this spout in consequence of careless use and not plugging. If a man will not plug he should let the spout remain in the tree until the leaves just start, and then remove it and the tree will not be injured. But allowing it to remain until the further growth of the tree, the injury is frequently increased.



Post's Spouts.

BUCKET.

I like tin buckets. To make good sugar they must be covered. There is a patent bucket with cover made by C. C. Post of Burlington which is perhaps the best arrangement, if one is to be newly set up.

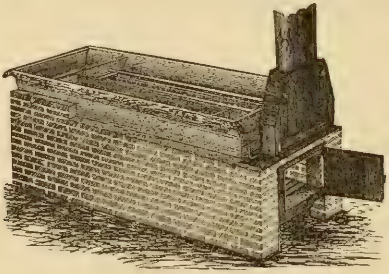


Post's Patent Bucket.

Persons who have their sugar-places all fitted need not despair, however, for I have seen in use a square piece of board cut just large enough to cover the bucket, and one side painted white and one side brown, laid just on the top of the bucket, the brown side up. Then as the sap was gathered it was turned over, white side up, and saved thus many a step, as whether or not the tree had been visited was shown at a glance. The next gathering it was returned as before.

BOILING.

In boiling it is conceded by most, and has been found true in my experiments, that the sugar is the lightest colored and best flavored when reduced in the quickest possible manner from the tree to sugar. If boiled in pans, in the ordinary way, the sap should be no more than two inches deep in the bottom, and may be run to advantage even more shallow, but constant care is necessary. It will always be found that those who boil with their pans nearly full will have a dark colored, bad flavored sugar. The cost of boiling is also much greater. Last spring I experimented with the Champion evaporator, manufactured at Richford. I think it one of the fastest boiling evaporators in use. It was a No. 2, and with good wood I could run ninety gallons of sap per hour. With experience, perhaps, it might reach 100. So far as I am able to judge it is a splendid device, and I think it better be examined by many boiling in the old-fashioned pan, as it much reduces the cost of boiling. Very nice sugar can be made by its use.



Champion Evaporator.

The principle upon which it is constructed is not very different from others, but the utility of the heat is very great. Dry wood is needed to run it with the best success, with a strict adherence to directions in setting up. Many a man fails in the setting and use of pans, heaters and evaporators, by trying what the mason or some one thinks a better way. I do not say that improvements cannot be made, but if so, they must be the result of long and careful experiment.

CLEANLINESS.

Cleanliness is doubtless everywhere next to Godliness, and nowhere is it more apparent than in sugar making. The best sugar makers strain their sap once, and if buckets are not covered, twice.

Then skim all that rises to the surface, and many strain the syrup also. The strainers used are generally white woolen flannel.

FERTILIZING MAPLES.

Like all other crops maples may be fertilized. Potash or ashes I have found not only increases the growth, but greatly increases the amount of sap flow, also the quantity and quality of the sugar. Gypsum (land plaster) also increases the sap flow, and all manures seem beneficial. Bone meal seems to increase the annual growth, but does not on my land have as beneficial effect upon the sap flow. I find the greatest benefit from fertilizing just as the leaves begin to fall in autumn.

REFORESTING WITH MAPLES.

Many have done this in this state with great success. I believe the better way is to plant the seed, or set the trees when very small. Some have set quite large trees, and cut back until they were hardly more than poles. This cutting back is never recovered from, and the trees are black-hearted, and do not run half as much sap as sound trees. Care should be taken not to transplant trees that require such heavy trimming. Maples can be profitably tapped in fifteen to twenty years from planting. One from seed seventeen years old in my grounds is sixteen inches in diameter.

AMOUNT OF SAP FLOW.

In my experiments upon sap flow I have found the following to be shown: That about two feet from the ground is perhaps the best point for tapping, as the sap flow in relation to quantity and quality may be considered the most profitable at that point. The average flow decreases quite rapidly upward, as I have found, the usual length of the trunk, and to become much less and yet sweeter among the limbs. The average percentage of sugar varies greatly in different trees and in different sugar-places, ranging as high as nine per cent in some cases, and as low as one per cent and even less at the other extreme. A tree tested for the season after potash fertilization averaged about seven per cent, and produced twenty-four pounds of sugar. The highest product of any tree ever tested by me was forty-two pounds; and the highest product of any sugar-place thirteen and one-fourth pounds in a season as an average from each tree. The average percentage of sugar from one of my best trees last spring was 5.14 per cent. There is a great difference in seasons, both as to the quantity and quality of sap.

EXPERIMENTALISTS' NOTES.

Experimentalists in this field are few. In Vermont I am not aware that any persons except myself and Timothy Wheeler, of Waterbury Center, have spent much time in such experiments. Mr. Wheeler has observed extensively though without instruments, which give absolute accuracy to positive experiment, but his observations are of much worth, and I give such extracts in his own language from the various published articles in the newspapers as I deem of most interest to the inquirer. As he is reliable in his observations, I believe these notes will be of use.

"Cold nights with the thermometer below freezing, and warm days with an occasional storm of snow, or at least a snowy atmosphere, are necessary for the free flow of maple sap.

"Maple sap will run better by day than by night. The brighter, lighter, and more sunny the day, the more freely the sap flows.

"As a rule trees are more or less active in the daytime, and rest more or less in the night. The darker the night the less sap runs, other conditions being the same. After three o'clock in the afternoon it will be noticed that as the sun declines the dripping sap lessens, even when there is no change of temperature.

"Sap caught during the day is sweeter than that caught at night. The nearer the occurrence of a freeze or a snow storm that sap is caught, the sweeter it is. The sap season of the maple is while the tree is not in leaf, a period of some six months. As soon as the leaves fall, the first freeze and thaw intervening, the sap will run, provided the tree is properly tapped.

"The first run of sap in the fall and the last in the spring has the smallest percentage of sugar in it. As the sap season advances toward the maximum flow, sometimes occurring in March and sometimes in April, sap increases in sweetness, and from this point it lessens until the close of the sap season.

"Sap also increases in quantity until the maximum and then it decreases. The sap first starts at the surface, and ends at the heart of the tree. The sweetest sap lies at the surface, while the poorest lies at the center, or near it. There is a grade of sap in each ring of every maple. These grades differ in color, taste and sweetness. Many do not credit this statement, but the most incredulous can be convinced by a few easily tried experiments. Sap grows sweeter and sweeter as we ascend the tree, from somewhere in the vicinity of from eight to twelve feet from the ground, but less in quantity. Quantity and quality do not go together. Sap is the sweetest in the sapwood, and it is the sweetest of all in the outside ring, or in the last year's growth. The sap decreases in sweetness but not in a regular gradation from circumference to center, and increases in color, so that the highest colored sap (on the same level from circumference to the heart), is the poorest in sugar, but in relation to altitude the highest sap is the highest colored, yet it is the sweetest. Sap will run earlier on the south side, but it will run later on the north side of the tree.

"The less depth we bore a tree the less sap we get, but the whiter is the product. The deeper we bore the darker the sugar, but the greater the quantity. Trees standing beside moist, swampy land, and beside warm running surface water, will run much sap. Trees standing beside a cold spring will run much and very sweet sap. The better the sap season the better the sugar. The observing sugar-maker has noticed that as the sun declines and the dripping sap lessens, the darker the evening the sooner the sap will stop. Many nights I have watched the maples to observe their habits when there was no freeze or lowering of temperature, and I find that sap will stop running before midnight, and commence again with sunrise in the morning. Light, then, seems a powerful agent in sap flow. Heat and cold are still more powerful, however. Freezing nights, with warm days following, will give us sap until that run is exhausted. Then we must have a storm of snow or rain, and if accompanied by a freeze a smart run follows. Even a small change to a stormy atmosphere and without a freeze, if it snows, will give a small run ; but the run will be in proportion to the severity of the change. The white maple will make nicer sugar than the rock maple, but not as much of it. A varied temperature is necessary for a full flow of sap. Good sap weather requires that the opposite ends of the maple should be affected by opposite degrees of temperature. In ordinary years sap caught from tappings ten feet apart in the same tree, differs in color, taste and sweetness, so as to be easily detected, but occasionally there is a year that the most careful testing will show but little difference. A stub, with the entire top broken off, will run sap freely, provided it was broken off the previous season. On an average it takes about sixteen quarts of sap to make one pound of sugar, yet I know of one tree which will make one pound of sugar from five quarts. Trees differ as much for sugar as cows differ for butter. Various trees will make all the way from no sugar at all up to thirty pounds and more per tree.

"There is no such thing as "buddy sap," but the change in taste is caused by temperature. Sap caught at a low temperature is sweeter than that caught at a high temperature. Nice white sugar cannot be made from all maple trees. Some sugar-places in consequence will make darker sugar than others with the same care."

SCIENTIFIC EXPERIMENTS.

In 1885 the United States Agricultural Department collected all it could of a scientific nature upon this subject, and sent Prof. Wm. Frear, one of its chemists, with all necessary scientific instruments, to Lunenburgh, to investigate the sap flow and what it contained. The following report was made from the result of our experiments and what other information was at hand. It was published first in a pamphlet upon general sugar making by the Department of Agriculture. From it I make copious extracts with modifications, the result of later observations in some instances. These observations are the outcome of careful experiment with all needed apparatus at hand.

The record of the chemical study of the maple saps, sugars, and sirups is very limited.

Julius Schroeder* has reported numerous analysis of the *Acer platanoides.*

His experiments were conducted as follows : Before the beginning of the flow of the sap the tree selected for experiment was bored in twelve different places. The lowest hole was bored 0.30 meter† above ground. Each succeeding hole was made at a distance of 1 meter from the preceding. The height of the tree was twelve meters. The tree began to branch at the second tapping, and continued branching

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*Versuchstationen, Band XIV, 1871, p. 118 *et seq.*
†1 meter is 39.37 inches.

regularly to the top. The estimation of the sugar from the various borings gave the following results:

Date.	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
April 19	2.51	......	......	......	......	......	......	......	......	......
20	2.67	(*)	......	......	......	......	......	......	......	......
21	2.70	3.10	2.58	......	......	......	......	......	......	......
22	2.44	(†)	(‡)	......	......	......	......	......	......	......
27	2.00	2.99	2.57	2.62	2.51	......	......	......	......	......
28	2.58	2.49	2.58	2.73	2.57	2.97	......	......	......	......
29	2.73	3.03	2.99	3.42	......	......	......	......	......	......
30	3.06	3.17	......	......	......	......	......	......	......	......
May 1	(†)	(†)	......	......	......	......	......	......	......	......
3	2.49	2.97	......	......	......	......	......	......	......	......
4	2.46	......	......	......	......	......	......	......	......	......
5	2.64	2.26	(†)	3.28	2.79	3.30	2.88	......	......	......
6	2.64	2.88	......	......	......	......	......	......	......	......
7	2.32	2.46	3.15	3.39	2.84	3.25	3.14	......	......	......
8	2.29	......	......	......	......	......	......	......	......	......
9	2.18	2.17	3.19	3.44	2.38	3.28	2.70	......	......	......
12	1.88	1.41	3.21	3.17	2.76	3.39	3.17	3.72	3.30	3.31
13	1.92	1.22	2.88	2.64	......	3.17	......	......	......	......
14	1.76	1.15	2.40	2.16	(†)	2.73	2.83	......	......	......
16	1.92	......	......	......	......	2.12	2.79	......	......	......

*Beginning of the flow, but too little for analysis.
†Too little for examination.
‡Analysis failed and no further substance at hand.

From this it appears that from the higher borings a sap richer in sugar was obtained. In similar experiments made with the birch tree the opposite was found to be true, *i. e.*, the sap from near the ground was richer in sugar than that from higher up.

The author explains this difference by the different distribution of the starch in the two trees.

In the birch little starch is found in the smaller twigs, while in the maple there is as much found in these as in the larger portions of the tree. He also found that during the flow of the sap the evolution of the maple buds was almost stopped, and hence there was no drain on the starch in the small twigs to support the growth of the buds.

The influence of the season on the sugar content of the sap is shown in the following table, calculated from the mean of the flow from the lower half of the tree.

Date.	Sugar.	Date.	Sugar.
	Per cent.		*Per cent.*
April 28	2.74	May 7	2.90
29	2.97	8	2.85
30	3.06	9	2.77
May 3	2.97	12	2.64
4	2.91	13	2.37
5	2.90	14	2.05
6	3.02	16	2.12

Up to April 30 the percentage of sugar increased, on which day it reached its maximum.

The decrease thereafter was very slow, so that it was first on the 9th of May that the percentage of April 28 was reached.

From this time on the decrease in the content of sugar was regular. The sap from the roots showed a similar constitution to that of the branches *i. e.*, it was richer in sugar than that from the trunk.

*Albuminoids contained in one liter of sap.**

Height of tap above ground.	Date.	Albumen	Sugar.
		Grammes.	*Grammes.*
0.3 meter	Apr. 27-28	0.0205	2.29
Do	29-30	0.0186	28.9
Do	May 3	0.0238	24.9
Do	5	0.0117	26.4
Do	7	0.0152	23.2
Do	16	0.0079	19.2
3.3	7	0.0251	33.9
5.3	7	0.0344	32.9
0.25	Apr. 29	0.0081	14.9
Root, 1 meter from trunk	29	0.0093	19.3
0.25	May 6-12	0.0131	12.6
Root, 1 meter from trunk	6-12	0.0130	18.6

*1 liter is 1.05 quarts.

The sap from the upper part of tree contained more albumen than that from the lower. Sap from the root in one case showed a higher, and in a second an equal content of albumen, as compared with trunk sap. Towards the end of the season the content of albumen grew less.

Ash contained in one liter of maple sap taken at different distances from the ground.

Date.	Height.	Ash.
		*Grammes.**
Apr. 27, 28	0.30	1.22
May 5	0.30	1.09
18	0.30	0.93
5	3.30	1.02
5	5.30	1.32

*1 Gram is 15.43 grains.

Ash contained in one liter of sap from trunk and root.

	Date.	Ash.
		P. ct.
Trunk, .25 meter from ground	May 5	.63
Root, 1 meter from trunk	May 5	.95

Composition of ash from maple sap.

Date.	Source of Sap.	Parts in one liter.					
		K_2O	Na_2O	MgO	CaO	Fe_2O_3	P_2O_5
April 27, 28	3 meters	0.2708	0.0096	0.0584	0.2404	0.0050	0.0968
May 5	...do....	0.3529	0.0040	0.0660	0.2262	0.0012	0.0646
18	..do.....	0.3009	0.0073	0.0524	0.1462	0.0097	0.0357
5	3, 3	0.3321	0.0321	0.0673	0.2142	0.0112	0.0415
5	5, 3	0.1345	0.0182	0.0921	0.2655	0.0267	0.0973
5	Trunk	0.1661	0.0056	0.0304	0.1798	0.0019	0.0354
5	Root	0.1857	0.0138	0.0281	0.0644	0.0025	0.0474

MALIC ACID.

Schroeder determined the malic acid as follows:

The sap was partially evaporated, treated with an equal volume of alcohol of ninty-five per cent, and left standing for some time, when the at first amorphous precipitate began to take on a crystalline form. The separated crystals were easily identified as malate of lime. The analysis of the silver salt of the acid gave the following numbers:

Constituents.	Found.	Calculated.
C	13.86	13.79
H	1.33	1.15
Ag	61.26	62.07
O	22.55	22.99

ANALYSES OF MAPLE SAP.

By Charles Wellington, B. S.*

Variety of trees.	Date, 1884.	Specific gravity at 15° C.	Sugar.	
			Glucose.	Sucrose.
Acer saccharinum	Mar. 26, 28	1.015	Trace.	2.777
Acer rubrum	Mar. 27, 28	1.010	0.012	1.458
Do	April 8	1.010	Trace.	0.833
Do	April 8	1.007	do	0.769
Acer Pennsylvanicum	Mar. 30, 31	1.010	do	1.428

*Report Massachusetts Board of Agriculture, 1874-'75, p. 290.

GAS FROM SAP OF ACER SACCHARINUM.†

Composition by volume.

Constituents.	Gas from sap.	Air.
	Per cent.	*Per cent.*
N	72.213	79.02
O	22.435	20.94
Co 2	5.352	0.04

†Report Massachusetts Board of Agriculture, 1874-'75, p. 291.

ANALYSES OF MAPLE SAP IN INDIANA.*

The orchard from which the specimens were taken is an old one which has been in use more than fifty years. It is situated two miles west of La Fayette.

The first determinations were made on the 21st of March, after two days of a moderately hard freeze.

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*Proceedings A. A. A. S., Saratoga meeting, vol. xxviii.

Specimens of sap were taken from twelve different trees, selected so as to represent in size, shape, age, &c., the average growth of the grove.

Following are the percentages of sugar obtained. I also give specimens taken from the same trees four days later, March 25, after two days and nights constant running.

Nos.	Per cent. March 21.	Per cent. March 25.	Nos.	Per cent. March 21.	Per cent. March 25.
1	3.95	3.44	7	2.51	2.00
2	2.95	2.63	8	1.95	1.87
3	3.26	2.80	9	3.08	2.00
4	2.70	2.34	10	2.67	2.34
5	2.70	2.60	11	2.70	2.11
6	3.20	2.42	12	3.51	2.74

The twelve trees above given had been "tapped" about a week before the examinations were made.

Wishing to try some perfectly fresh trees, specimens of sap were taken, on March 25, from three fresh trees, which gave in the polariscope the following numbers:

Nos.	Per cent. sugar.
1	3.93
2	3.75
3	2.42

The sap from a tree in Southern Indiana, taken near the end of the season and sent by express to La Fayette, Ind., gave, on examination three days after collection, *sucrose* 4.30 *per cent.*

This tree was noted for the richness of its sap, and was known as the "sweet tree."

The following analyses of maple sugars and sirups were made by this Bureau, previous to the beginning of the work in Vermont, during the season just passed:†

Inasmuch as the maple sap is always evaporated in open pans, it is not strange that the sugars and sirups contain invert sugar. On the other hand, in many cases the percentage of invert sugar is surprisingly low. These cases indicate that in pure aqueous solutions of sugar, heat does not invert the sucrose as rapidly as if mineral salts and organic impurities were present. A study of the proportion of inversion due to heat and to other causes would be of interest. Samples for analyses were purchased in open market and directly from retail manufacturers. Opportunity was thus afforded to compare the genuine with the commercial articles.

The results of the analyses, presented in the following tables, show to be true what has long been suspected, namely, that the commercial articles are largely adulterated. The commercial sirups are quite uniformly mixed with starch sugar, or glucose. No method of analysis, however, will detect a kind of adulteration which is probably common, that of the addition of cane or beet sugar to the maple. All of these sugars are identical chemically.

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†Chemical News, vol. 51, No. 1317, p. 88, *et seq.*

Of the sirups, Nos. fourteen to twenty, inclusive, are known to be genuine. Excluding from these No. fifteen, which had been made for more than a year and had undoubtedly undergone partial fermentation, it is seen that the sucrose varies from 39.22 per cent to 64.45 per cent. The invert sugar(glucose), on the other hand, varies from 0.21 per cent to 3.24 per cent. The percentage of water is, as an average, astonishingly large—over thirty per cent.

Of the sugars Nos. fifteen to twenty, inclusive, are known to be genuine. In these the sucrose is quite constant, about eighty-four per cent, while the invert sugar varies between 0.80 and five per cent. The water is much higher, too, than one would expect.

Some curious results are shown by the analyses. Notice, for instance, the difference in sirups Nos. 2 and 3, 4, 5. In case of No. 2 the analysis clearly reveals a large addition of glucose. Nos. 3 and 5 had only a trace of reducing sugar. This is also suspicious. It shows that the samples were made, probably, by adding to a sirupy solution of cane sugar enough dark maple sirup to give it color and flavor. It is difficult to suppose that a maple sap evaporated to a thick sirup in an open pan would contain only a *trace* of reducing sugar. No. 4 is a genuine maple sirup.

In Nos. 9 and 10 are also found some interesting data. Both of these sirups are probably genuine, although differing so greatly in composition. If No. 10 is an adulterated sample the admixture is not glucose, but refining molasses. In glucose there are always dextrine and maltose, which were not determined above. In No. 10, therefore, there can be no glucose, else it would partly appear in the undetermined column. On the other hand, the percentage of reducing sugar is very high, indicating a possible addition of refining molasses: but the low percentage of ash in this sample is an evidence of its purity.

In No. 13 is found a sample from the butternut tree (*Juglans cinerea*).

Unhappily there is no method of detecting the adulteration of maple sugar with other sucroses. The temptation to this adulteration is great, because maple sugar commands nearly double the price of other sugars; but neither chemistry nor optics will help to a decision in a question of such an adulteration. If enough of the real maple sugar is present to give the characteristic odor and flavor, the sample must pass.

Lately in the United States a patent has been secured for manufacturing the maple flavor. It is done by extracting hickory bark with water, and the separation and purification of the product. This extract added to glucose or cane sirups gives them an odor and flavor very like the maple.

MAPLE SIRUPS.

No.	Sucrose by double polarization.	Invertose.	Water.	Ash.	Undetermined.	Description and remarks.
1	50.49	9.90	32.39	0.33	6.89	Thuber's Mountain sirup, quart bottles, bought in Washington, D. C.
2	22 94	27.77	25.06	0.58	23.65	Vermont maple sirup (McClary), quart bottles, bought in Washington, D. C.
3	63.57	Trace..	31.52	0.69	4.22	Vermont sirup kept in bulk, bought in Washington, D. C.
4	57.94	5.52	29.14	0.44	6.96	Do.
5	61.25	Trace..	29 68	0.74	8.33	Do.
6	32.07	32.79	19.01	1.00	15.13	Western Reserve (Black Bros.), ½ gallon cans, bought in Washington, D. C.
7	57.71	13.24	31.34	1.14	6.57	Western Reserve (Black Bros.), kept in bulk, bought in Washington, D. C.
8	61.41	1.58	28.72	0.82	7.47	Hazen's Vermont sirup, quart bottles, bought in Washington, D. C.
9	63.78	2.00	26.69	0.84	6.69	Ohio sirup, from Mr. La Dow, Washington, D. C.
10	49.46	17.24	33.98	0.38	....	Ohio sirup, kept in ½ gallon cans, bought in Washington, D. C.
11	29.41	17.57	33.66	0.86	18.50	Do.
12	64.26	0.66	31.28	0.74	3.06	Hazen's Vermont sirup, in quart bottles, bought in Washington, D. C.
13	44.54	16.00	40.26	0.79	....	Sirup made from butternut tree, from F. B. Hough, New York.
14	62.23	0.21	35.21	0.55	1.80	Maple sirup, from F. B. Hough, New York.
15	42.09	17.54	33 74	0.95	5.68	Maple sirup, made in 1883, from M. J. Smith, Middlefield, Mass.
16	54.80	3.24	38.58	1.03	2.35	Maple sirup, made from last run of sap in 1884, from M. J. Smith, Middlefield, Mass.
17	63.87	1.39	32.11	1.71	1.92	Maple sirup, made in middle of season 1884, from M. J. Smith, Middlefield, Mass.
18	64.45	1.39	31.67	0.76	1.73	Do.
19	62.90	1.78	32.84	0.68	1.80	Maple sirup, made early in season of 1884, from M. J. Smith, Middlefield, Mass.
20	39.22	1.79	36.72	0.94	21.33	Maple sirup, made in 1883, from M. J. Smith, Middlefield, Mass.

MAPLE SUGARS.

1	84.24	6.33	8.03	0.31	1.09	In bulk, bought at Washington, D. C.
2	81.67	9.26	8.84	0.97	....	Do.
3	79.08	6.02	11.57	0.91	2.42	Do.
4	71.80	12.19	9.73	0.70	5.58	In small cakes, bought at Washington, D. C.
5	86.27	5.91	6.77	0.76	0.29	Do.
6	86.52	Trace..	8.63	1.06	3.79	In bulk, bought at Washington, D. C.
7	80.22	6.89	8.68	1.30	2.91	Do.
8	86.24	4.54	7.82	0.41	0.99	Do.
9	84.58	1.11	9.74	0.96	3.61	Do.
10	84.51	3.22	8.24	1.26	2.77	Do.
11	85.42	0.87	8.78	0.67	4.26	Do.
12	84.14	6.57	7.47	0.49	1.33	Do.
13	85.68	0.43	10.81	1.21	1.87	Do.
14	85.13	2.23	6.83	1.50	4.31	Do.
15	84.72	0.80	9.53	1.21	4.54	Sugar made early in season 1884, about March 20, from M. J. Smith, Middlefield, Mass.
16	82.36	2.10	10.75	1.25	3.54	Do.
17	86.97	1.69	7.68	1.06	2.60	Do.
18	86.28	2.10	7.59	1.27	2.76	Do.
19	86.89	2.08	7.96	1.06	2.01	Sugar made from last run of sap in April, from M. J. Smith, Middlefield, Mass.
20	82.07	5.00	9.26	1.16	2.51	Do.

Analyses of sirups and sugars collected during 1885.

SIRUPS.

No.	Sucrose.	Invertose.	Moisture.	Ash.	Albuminoids.	Undetermined.	Descriptive remarks.
1	54.20	2.29	40.23	.354	.019	2.737	Made by H. Day, Lunenburgh, Vt., April 9.
2	65.19	.78	25.13	.598	.045	8.258	Made by Hosea Thomas, Lunenburgh, Vt., April 8.
3	44.88	8.27	39.17	.504	.063	7.113	Made by Harrison Stowell, Lunenburgh, Vt., April 9.
4	62.19	.45	31.58	.573	.025	5.182	Made by V. E. Hartshorne, Lunenburgh, Vt., April 9.
5	52.36	1.15	40.03	.527	.050	5.883	Made by Porter Smith, Lunenburgh, Vt., April 16.
6	61.11	1.98	35.63	.516	.044	.720	Made by Fred. Luce, Lunenburgh, Vt., April 20.
7	55.84	3.56	38.30	.647	.050	1.603	Made by Fred. Luce, Lunenburgh, Vt., April 22; unfiltered.
8	57.51	6.06	29.92	.842	.075	5.593	Made b Wesley Stewart, Lunenburgh, Vt., April 23.
9	62.10	.56	33.17	.617	.044	3.509	Made by Chester Thomas, 1884; preserved in cork bottles; very light-colored.
10	61.30	.61	31.52	.442	....	6.128	Made by Simon Perkins, Randolph, Portage County, Ohio, 1885.

SUGARS.

1	83.02	2.31	....	.693	....	13.977	Made by Wesley Stewart, April 8.
2	84.34	.78	8.54	.842	....	5.498	Boiled down in small pan without skimming.
3	84.00	.44	12.48	.602	... .	2.478	Made by Ezra Pierce, Lunenburgh, Vt; milk used to raise scum.
4	85.25	....	8.62	......	....	6.13	Made by Hosea Thomas; from top of large can.
5	76.83	....	14.65	.755	....	7.768	Made by Hosea Thomas; from bottom of large can.
6	81.40	.56	6.16	.735	....	11.145	Made by Chester Thomas; small molds; very light-colored.

OBSERVATIONS MADE IN VERMONT.

Arrangements were made with Dr. H. A. Cutting of Lunenburgh, Vt., by which a representative of this bureau was permitted to make some chemical studies of the maple sap during the present season, in connection with himself. The season was a very short one, and yet a start was made. Prof. William Frear was instructed to take charge of the Lunenburgh station, and to collect as much information as possible concerning the maple sugar industry. He went to Lunenburgh on April 3, and remained until the close of the season, in the early part of May.

Following is the report then made:

SOURCES OF MAPLE SUGAR.

The Rock, Hard or Sugar Maple (*Acer saccharinum*, Linn.) is correctly regarded as the prime source of maple sugar; but while it is well known that in northern climates all species of maple yield sap containing more or less sugar, it is not generally supposed that any other species than the rock maple is extensively used as an available source in the actual manufacture. In Vermont favorable conditions exist for the growth of most species of maple found in the northeastern part of the United States; several species in particular are very flourishing, and have been much used as sources of sugar in addition to that afforded by the rock maple. To so great a degree has their use for this purpose grown that excellent authorities claim that at least 50 per cent of the trees tapped in Vermont are of other species than the rock maple. Without attempting to make any accurate estimate in this matter, it may safely be claimed that these species, as well as the rock maple, deserve attention in the study of maple sugar production.

The Red (yet called White Maple), Silver, or Soft, or Scarlet Ma ple (*A. rubrum*, L.) though considered as a lowland tree, is found in Northern Vermont growing high on the hillsides among the rock maples. This species ranks next in importance to the latter in relation to sugar production.

In Essex county there are few groves which are composed exclusively of rock maple. In a large proportion from one-third to one-half is of white, or soft maple, as it is more commonly called, and at least one grove is known which is entirely made up of this species.

The trees are frequently very large, and the general conditions favorable to the best production in the rock maple have a like effect upon this species. The sap, though generally inferior to that of the rock maple in sweetness, is clear, and flows in good quantity.

A peculiar purplish coloration of the sap is noticed for two or three days after tapping, but it is not generally sufficient to materially affect the manufactured product. A similar coloration of the bit used in tapping is noticeable, and may be attributed to the action of the fresh juice of the bark upon the iron.* It is claimed by many that the sap yields a whiter sugar than even that of the rock maple.

The Black Maple, or Black Sugar Maple(A. *saccharinum*, var *nigrum*, Torrey and Gray; A. *nigrum*, Machaux), occurs under conditions favorable to rock maple with considerable frequency, though greatly less abundant than the A. *rubrum*. Having so much in its appearance in common with the rock maple, it often passes unnoticed, and in consequence, may be of more importance as a factor in production than it is now supposed to be. It attains proportions and heights similar to those of the rock maple, and in the quantity of sap yielded is not inferior. It is claimed by some that the flow ceases sooner than in the case of the rock maple, but this season's observations fail to support the claim. The sap is clear, of good flavor, and in sugar content fully up to the average sap of the rock maple.

The Swamp, or River Maple(A. *dasycarpum*), though of comparatively infrequent occurrence among the mountains of Northern Vermont, is quite abundant in low swampy grounds in other sugar-producing localities. While it does not generally attain any great size, it may under very favorable conditions reach a height of 70 or 80 feet, and a diameter of 3 or 4 feet. It makes a pleasant flavored

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*Michaux notes the blue coloration yielded by the wood of the Red and White Maples when treated with a solution of sulphate of iron as a test to distinguish it from the Rock Maple, which strikes a greenish color. The bark is claimed to have considerable value as a dyeing material.—*Emerson, Tree and Shrubs of Massachusetts,* Vol. II, p. 562.

sirup or sugar, as light in color as that from any other sap. Its yield of sap compares favorably with that from other species in trees of similar size; in clearness it surpasses all the other species, but it contains the least amount of sugar. It tastes slightly astringent at times, and, if, boiled in iron vessels, is said to turn black.* Evaporation out of contact with iron, however, yields a light-colored sirup or sugar of very pleasant flavor.

The other species of maple which are found in Northern Vermont are comparatively rare, and attain too small proportions to be of any practical value as sugar producers. Dr. Franklin B. Hough, in a recent paper on the maple sugar industry† says that in Southwestern New Hampshire the red maple (called white maple by lumbermen) is tapped as often as the true sugar maple, and that the sap is really about of like value; that in the Western Reserve, Ohio, both red and white maples occur abundantly, and are used in manufacture, while in Logan County the black maple is the source from which large quanitities of sugar are made; that the last-named species is used also in Arkansas, though the production there is slight.

He also notes the use on the Pacific coast of the sap of the cabinet maple (*Acer macrophyllum*) for making sugar and sirup. Mr. J. C. Brown, in the same report, p. 390, says that the sap of the vine maple (*Acer circinatum*) contains a large amount of sugar, and is frequently made into sirup.

Dr. Hough and other authorities also note the frequent use in Middle Western States of the sap of the ash-leaved maple, or box-elder (*Negundo aceroides*), a species closely related to the maples. It is said to contain a good amount of sap, which averages 2.8 per cent of sugar, and to yield lighter-colored products than are produced from the sugar maple.

I would also note that in the report of the Department of Agriculture the Red Maple proper, always called "White Maple," here was accidentally named as A. *dasycarpum* instead as A. *rubrum* which led to errors in other statements, all here corrected.

CONDITIONS AFFECTING THE FLOW OF SAP.

It has been observed that the quantity and quality of sap vary with the situation of the trees, their age and size, the nature of the season and of the preceding season, the meteorological conditions, and the methods of tapping. The general conclusions resulting from the experience of sugar makers have been collated from as many sources as possible, and will be noted in their proper order. The frequency of direct contradiction in the testimony, however, opens up many questions of great interest relating to plant physiology and chemistry.

THE SITUATION OF THE TREES.

Every sugar-maker is aware that the productiveness of a grove varies much with its position; and there are a great many theories to account for the differences. The facts observed may be most satisfactorily grouped under the following heads:

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* The bark is well known as a dyeing agent, and as a source of ink among the earlier farmers of New England. *Bancroft, Philosophy of Permanent Colors*, II, 272; *Emerson, Trees, Shrubs of Massachusetts*, II, 555.

† Report on Forestry, Department of Agriculture, 1884, p. 394 *et seq.*

Elevation.—It is generally accepted that trees on a high elevation will yield sap which is sweetest, but not so great in quantity; whether or not the sugar product is greater than in the case of lowland trees is disputed. In several instances coming under my observation groves situated on high rocky ledges have yielded a larger weight of sugar to the tree than those in neighboring groves at a lower elevation. It has also been observed that, other conditions being similar, trees in elevated positions begin to flow sooner than those in the valleys. This would probably have a favorable influence upon the final yield.

Direction of exposure.—Owing to causes similar to those affecting trees at varied elevations, the direction of exposure has much to do with the yield of sap. The warmest and most protected groves flow earliest and with least interruption. The favorite sites are those with southern and eastern exposure. Those groves facing north and west are sometimes several weeks later than their neighbors on the opposite sides of the mountain.

Thickness of growth.—Exposure to sunlight and a full development of the tree being advantageous, the thickness and character of the growth has, of course, a marked effect upon the yield. Where the trees are planted thickly, not only is the ability of the tree to store up the sugar-producing elements reduced, and its growth retarded, but also the shading of the trunk and roots from the rays of the sun lessens the flow of the sap, and delays the period at which it begins. On the other hand, the flow is often longer than in more exposed positions. Without exception, nevertheless, it is admitted that isolated trees yield not only the earliest and most sap, but also the sweetest.

Further, it is regarded as particularly important that other kinds of trees should be removed from a grove; especially such as spruce and hemlock, which shut out the rays of the sun, and whose falling needles are likely to injure the sap in the pails. A growth of these trees on the side most exposed to the wind will, however, frequently afford much protection, and cause an earlier sap flow.

The number of trees which can most profitably be grown on an acre will vary much with the position of the grove. According to C. S. Sargent* 160 may be considered as a fair number for medium-sized trees in flourishing condition.

Moisture.—It is generally admitted that trees in wet ground yield the most sap. There is much dispute, however, concerning the relative quantities of sugar produced, as it is noticeable in a great number of cases that sap when running most rapidly is not so sweet as when flowing at a much slower rate.

The majority of makers adhere to the saying, "*The more sap the the more sugar;*" and as far as exact observation has been made, this opinion seems in the main correct, but it certainly is subject to numerous exceptions.

Soil.—In addition to the warmth and moisture of the soil, other physical characters and its chemical constitution are regarded as influencing the sugar production. A loose rich loam is desirable. A. M. Foster of Cabot, Vt.,* prefers slate or limestone land to granite. Dr. Cutting, says that he has found by experiment that the application of fertilizers increases the sugar product of the following season. As an instance of the effect of soil constituents upon the quality of the sap, E. A. Fisk, of Waitsfield, Vt.,† records a case in which some spent tanbark produced a decided coloration of the sap which disappeared only on the removal of the tan. There is room for much interesting experiment on the effect of fertilization upon the yield and qualities of maple sap.

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*Agriculture of Massachusetts, 1874—'75, p. 270.

SEASON.

Effect of preceding seasons.—The flow of sap varies not only with the season or period of flow, but also with the character of the preceding seasons. T. Wheeler, of Waterbury Center, Vt., gives "an Indian rule" for determining the yield of sap in advance, which he had noticed several years without failure: "If the maple leaves ripen and turn yellow, and the buds perfect themselves so that the leaves fall off naturally without a frost, then there will be a good flow of sap the following spring; but if there is a hard frost that kills the leaves and they fall off prematurely before the bud is perfected, then we may look out for a poor yield of sap."‡

Emerson says: "A summer of plentiful rain and sunshine—that is, one which furnishes the tree with abundant nutriment, and is at the same time favorable to the elaboration of the saccharine matter and its deposition in the vessels of the wood of the tree—ought naturally to prepare a plentiful harvest of sugar for the subsequent spring."§

An open winter is also favorable to the best yield.‖ The sap flows earlier and the time of flow is generally longer. The quantity of sap also is greater and the percentage of sugar considerably higher. The data at command seem to indicate an increase of all solid constituents as the result of the conditions accompanying such a season.

Time of flow.—It has been found that sap will flow with more or less abundance during any of the months between October and May, and even in the last named month when the spring is especially late. The time is much more limited during which the flow is abundant and regular, and the sap yielded is in best condition. The date at which the trees are usually tapped varies considerably with the locality, as well as with the nature of the season. According to Dr. Hough, the season generally begins in Southeastern Indiana about the middle of February. In Northern Vermont the season rarely begins as early as the middle of March, and sometimes not till the second week of April. The duration of the period of flow is quite variable, but as a rule it is shorter when it begins late.

The total quantity and composition of the sap for a season vary with its earliness and duration, though there is a wide variation due to special conditions of weather, which affect the regularity of the flow. As a rule the earliest and longest seasons yield the greatest quantity both of sap and of sugar; notwithstanding in a late season the maximum daily yield is frequently higher than in seasons of longer duration.

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* Vermont Agricultural Report, 1874, p. 728.

† *Ib.*, 1874, p. 717.

‡ *Ib.*, 1874, pp. 723, 724.

§ Trees and Shrubs of Massachusetts, Vol. II, p. 562.

‖ In Southeastern Indiana and other localities of a similar climate the best sugar seasons follow the severest winters. But a "severe winter" there would be called an "open winter" in Vermont.

During every season there is a marked periodic variation in the quantity and composition of the sap. T. Wheeler, of Vermont, writes that the sap increases in quantity, density, and sweetness up to a certain time. and then again gradually decreases until the close of the season. The maxima of these different properities do not occur on the same date. Other writers confirm this observation more or less completely.*

Toward the close of the season the sap generally becomes thick, amber-colored, and opaque, and loses its pleasant flavor.

METEOROLOGICAL CONDITIONS.

While there seems to be an invariable periodic change occurring in every season, there are also numerous daily and hourly variations which are attributed to changes in the weather. General observation has led to the following conclusions concerning the effect of particular meteorological conditions:

A wide range of temperature for each day is most favorable. The sap seems to run only when there is an alternation of thawing and freezing. A thawing night is always unfavorable, while a freezing day, of course tends to stop the flow.

A westerly wind is favorable, but southerly and easterly winds diminish or entirely stop the flow. Providing there is no great change in temperature, no variation has been noted on account of changes in the velocity of the wind.

Clear skies are most favorable. At the approach of a storm the flow lessens or ceases. Very frequently, however, after a fall of rain or a light snow there is a great increase both of sap and of sugar produced, though the actual percentage of sugar in the sap may be slightly lower. A layer of snow and frozen ground over the roots of the trees is always favorable to the highest yield.

While the above rules are of general application, striking deviations are of frequent occurrence, for which no adequate cause has yet been discovered.

VARIATIONS IN TREE.

As would be expected, trees of different age and growth produce sap in varying quantities and of different composition. Many sugar-makers believe that the "first" or "old growth" trees yield a greater amount of sugar than the "second growth," and that the sap is better in flavor and color. Mr. Hosea Thomas, of Lunenburg, states that he has boiled sap from "first" and "second growth" trees alternately for several days, and in every instance obtained a lighter-colored sirup from the sap of the "first growth" than from the "second."

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* This is a point which should be studied by more numerous analyses.

The size of the top is also known to be a potent factor in production. A tree with numerous spreading branches gives sap in greater quantity and of better quality than a tree with a small, slender top. Some observers claim that this factor is important only in the case of "second growth" trees; but their statements are by no means received without question. Whatever the fact in the case may be, it is readily seen that a large spreading top is the means of bringing into play increased elaborative force, and an increase in the quantity and quality of the sap would naturally follow.

The age, and consequently the size, of the tree in general is also an important element. It is well known that the largest amounts of sap and the richest saps come only from large trees, and that when a small tree yields a large amount of sap and a very rich sap it may be regarded as exceptional. This applies, however, only to trees in flourishing condition. A young tree in active growth will, from readily understood causes, yield a greater quantity of sugar than a very large tree with little vitality. It has further been observed that quite small trees cease flowing more quickly than those of much greater size and are more sensitive to changes of weather. As a rule trees under twenty or twenty-five years of age and under 8 or 10 inches in diameter are rarely tapped. This is not always because of the injury which many suppose to follow tapping in the case of young trees, but because the yield is too small to pay for the attention required.

TAPPING.

The last of the general conditions which affect the quantity and quality of the sap obtained from different trees is the method of tapping.

The first difference may be noted by varying the depth of the bore. President Clark, in his studies on sap-flow, states that the sap taken from the heart alone is much smaller in quantity, but that the flow is of much greater duration, than is the case with sap from the alburnum.

T. Wheeler states, as the result of his experiments on this subject, that while a deep bore yields more sap and more sugar, it is of a quality greatly inferior to that obtained from a shallower bore. Moreover, the deeper the bore the greater the injury to the tree.

The size of the bit used in tapping is of importance, more in view of the injury produced by a larger wound than by reason of any variation produced in the quantity or quality of the sap. Practically as much sap flows when a ⅜ inch bit is used for tapping as when a ⅝ inch bit is used, while the wound is much more readily healed.

The height at which boring is made also influences the product, both in quantity and quality, there being a very marked difference at intervals of only a few feet. The lower the tap is put in, the greater will be the yield of sap and sugar, though sometimes there is really a larger percentage of sugar in the sap from higher portions of the tree.

The number of taps in a tree affects the yield in quantity, at least, though no changes in the quality have been recorded as a consequence of an increased number of taps. It is considered of very questionable utility to tap small or medium-sized trees in more than one place, because of the injury resulting from the greater number of wounds.

Trees tapped on the south and east sides yield sap earlier and in greater quantity than those tapped on the north and west sides. On the latter sides the flow continues later, and the sap is sometimes the sweetest, taking the average through the season ; but the greater flow of sap on the south and east sides produces a greater quantity of sugar in spite of its slightly smaller percentage. President Clark says that the south side yields twice as much as the north side ; this proportion is probably higher than can safely be claimed in all cases, but the difference is always notable.

The frequency of tapping is also regarded as a factor in production. It is commonly accepted that the sweetness of the sap increases in proportion to the frequency of tapping.

EFFECT OF TAPPING ON TREES.

There is much dispute as to the effect of tapping on trees. When the borings are deep of course the trunk is weakened, and a large cavity is left which is not refilled by new growth. Generally the fresh wood caps over the holes in the course of one or two years, but it often happens that the wound is never fully healed. For this reason some makers claim that the large shallow cut made by the ax, in the old fashioned method of tapping, is less injurious than the small but deep hole made in boring.

When trees are tapped too early, and intense cold weather sets in afterwards, the bark around the boring is sometimes loosened by the expansion due to the freezing of the moist layer just inside. This is very injurious. It has also been noted that if the spouts are removed too early and the sap leaks down between the outer layers of bark, a large strip just below the boring will turn white and drop off, leaving a surface which is covered only with great slowness. Further, when nails are driven into the trees to hold the pails, a similar injury results, as well as a frequent rotting of the wood about the nail-hole.

Mr. Wheeler claims that tapping diminishes the elasticity of the wood, but no other observers note this as a fact.

Notwithstanding these disadvantages, the fact that large trees have been tapped for fifty and one hundred years without being killed in the process, and that, when compared with trees of the same age not often tapped, they are found to elaborate sap in larger quantity and contain more nutritive material, points to the conclusion that, with care, the injury to fair-sized trees is immaterial.

When used for lumber afterward, the few feet of the butt which show the marks of tapping are rejected, but mainly from fear of the nails which may be present.

DESCRIPTION OF EXPERIMENTS.

The trees from which the samples were taken for experiment were selected to represent, as far as possible, the varied conditions by which the quantity and composition of the sap are supposed to be influenced. They are as follows:

No. 1. Swamp maple, in low land, near a large brook, in thick woods but with a fair exposure on the south side. Height, 20 feet; circumference, 7 inches. Tapped on the south side.

No. 2. Swamp maple, near No. 1, but on a little higher and dry ground, with less exposure to the sun, and only about 2 feet from a large birch. Height, 40 feet; circumference, 40 inches; fair top. Tapped on east and west sides.

No. 3. White maple, in an isolated position, in a dry and elevated pasture. Height 60 feet; circumference, 96 inches; with good branching top. Tapped on east and west sides.

No. 4. White maple, at the foot of a sharp incline, and on somewhat swampy ground, but in an isolated and moderately elevated position; roots shaded by a high stone fence. Height, 50 feet; circumference, 110 inches; large top. Tapped on north and south sides.

No. 5. Black maple, in the pasture near No. 4, but in closer proximity to other trees. Height, 60 feet; circumference, 66 inches; good top. Tapped on the south side, at height of 1½ feet.

No. 6. Black maple, about a rod distant from No. 5. Height, 55 feet; circumference, 53 inches; fair top. Tapped on the north side, at height of 2 feet.

No. 7. White maple, in the same pasture, but entirely isolated. Height, 20 feet; circumference, 34 inches; small top. Tapped on the south side.

No. 8. Rock maple, set out in 1860. Stands on high ground and on the north side of a house in a lawn closely planted with well-grown trees, among them some spruce; exposed to the sun at noon. Height, 55 feet; circumference, 35 inches; small top. Tapped in the south side.

No. 9. Striped maple, *Acer Pennsylvanicum*, in same lawn; much shaded. Height, fifteen feet; circumference, seven and one-half inches; small top. Tapped on the north side two feet from ground.

No. 10. Rock maple, from a row of trees in a lane; ground high; good exposure to the sun. Height, fifty-five feet; circumference, thirty-seven inches; good top. Tapped on the north side.

No. 11. Rock maple, in same lane; shaded in the afternoon. Height, sixty feet; circumference, forty-eight inches; very good top. Tapped on the south side.

No. 12. Rock maple, in lane: much shaded in the morning and early afternoon by a thick spruce. Height, fifty-five feet; circumference, thirty-eight inches; very good top, branching about fourteen feet height. Tapped on the west side in four places: (1) At two feet height, (2) at five feet, (3) at eight feet, (4) at eleven feet.

No. 13. Rock maple, set out in 1869. Stands in lawn and is much shaded on the south and west sides. The top was cut off in 1875, but a large limb sprang up vertically in its place. Height, twenty-five feet; circumference, sixteen inches; slender top. Tapped on the north side.

No. 14. Rock maple, from seed planted in 1860. In lawn at the northeastern corner of the house; much shaded. Height, forty-five feet; circumference, forty inches; medium top. Tapped on the south side.

No. 15. White maple, in the lane. Height, forty feet; circumference, thirty-one inches; medium top. Tapped on the south side.

The above-mentioned trees were tapped on April 7, when the snow was two to two and one half feet deep. Later on in the season samples were taken from other trees previously tapped, which have the following characterstics:

No. 16. Rock maple, in the lawn. The top is shaded most of the day by a thick spruce tree, but the trunk has full exposure to the sun. Height, fifty feet; circumference, thirty-seven inches; fair top. Tapped on the southeast side.

No. 17. Rock maple, in the lawn. Top quite full and not shaded; trunk shaded by a small spruce. Height, fifty feet; circumference, thirty-nine inches; good top. Tapped on the southwest side.

No. 18. Rock maple, in the lane. Full exposure in the morning, but shaded the rest of the day. Height, fifty feet; circumference forty inches; very good top. Tapped on the east side.

No. 19. Rock maple, "old growth," in Alvin Thomson's camp; situated in wet ground at the foot of the hill near a large brook. Height, eighty feet; circumference, 143 inches; good, gnarly top. Tapped on the north side at height of five feet.

No. 20. Rock maple, "old growth," in same position. Height, eighty feet; circumference, ninety-six inches; spreading top. Tapped on the eastern and western sides at height of five feet.

No. 21. Rock maple, in F. Luce's camp, situated in low, wet ground, shaded all day by thick spruce tops. Height, fifty feet; circumference, fifty-seven inches; good top. Tapped on the western side.

No. 22. Rock maple, near No. 21; with very large roots; much shaded. Height, sixty feet; circumference, forty-six inches; small top. Tapped on the western side.

No. 23. White maple, in Luce's camp; situated on dry ground on a hill top, in an isolated position. Height, sixty feet; circumference, 119 inches; large spreading top, branching out at the height of ten feet on the eastern, northern, and western sides.

No. 24. Rock maple, in Luce's camp; near a rivulet; ground boggy; trunk very gnarly; near other large trees. Height, fifty feet; circumference sixty inches; good top. Tapped on the south side at a height of five feet.

No. 25. Black maple, on a dry knoll in Luce's camp; sunny exposure. Height, thirty-five feet; circumference, fifty-five inches; large spreading top. Tapped on the north side at a height of two feet.

The trees, with two exceptions, are "second growth." The soil is such as would result from the decomposition of granite and talco-schist, and is quite loamy. The trees were tapped with a ½ inch bit to a depth of 1½ inches, and unless otherwise specified at a height of three feet.

The spouts used were galvanized, and supported the tin pails. The sap was gathered from Nos. one to fifteen, inclusive, as frequently as possible, weighed and sampled for analyses. Average samples were taken from the pails of Nos. sixteen to twenty-five, without determining the quantity of sap. There was a slight quantity of sap which was spoiled by the rain of the 8th instant, and is not included in the total flow; but it would not appreciably alter the results.

SEASON NOTES.

The summer of 1884 was fair, but the winter season was long and cold. In the middle of March the temperature was down to—30 ° F., while the snow was several feet deep.

Sap did not commence to flow until the beginning of the second week in April. In the warmer days which ensued the snow rapidly melted, but had not disappeared even in open fields as late as the 17th.

On the morning of the 8th there was a shower which added about 170 grams of rainwater to each sample; later in the day heavier showers occurred, which almost stopped the flow, and made any attempt at estimation useless. The following day was freezing, and consequently the flow was not resumed until the 10th; from which date it continued without cessation in most cases until the 23d. On the 21st there was a slight rain, and an inch or more of snow fell on the 26th, which caused a slight second flow, so slight that only in one case was enough sap gathered for analysis.

During the period of flow the alternations in temperature were marked. According to observations made by the use of self-registering maximum and minimum thermometers, the highest temperature was 81 ° F,, occurring on the 23d; the lowest, 2 ° F., on the 9th. The greatest difference between the daily maximum and minimum was 38 ° F., and was found to occur on the 9th, 20th, and 24th; the difference between the maximum of the 24th and the minimum of the 26th was 58 ° F. The smallest difference was 12 ° F., occurring on the 28th. The mean daily difference from the 7th to the 28th, inclusive, was 26.5 ° F.

The prevailing winds were northerly and easterly in the mornings and evenings, but frequently veered to the south at midday. There was not a really strong wind during the whole season.

More than half of the time the sky was perfectly clear, and when there were clouds they were generally light cumuli, rarely covering more than .5 to .8 of the sky.

ANALYSES OF MAPLE SAPS, ETC., AT LUNENBURGH, VT.

In table No. 1 are found the percentages of sucrose in the saps of fifteen trees, together with the quantity of sap given by each tree from April 7 to 29.

TABLE I.—*Percentages of sucrose and weights of sap.*

Date.	Number 1.		Number 2.		Number 3.		Number 4.		Number 5.	
	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.
	P. ct.	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*
April 7	.....	.....	2.32	1,448	5.95	4,593	.....	.....	.....	.....
8	.....	.....	.....	.....	.....	.....	3.81	3,813	2.67	3,798
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	.....	.....	2.71	3,629	5.39	3,232	4.48	2,140	4.03	1,176
13	.....	.....	.....	.....	5.17	16,287	4.17	9,086	2.78	2,267
14	2.92	198	.....	.....	5.23	9,525	2.98	9,554	4.26	2,353
15	.....	.....	2.69	1,956	5.06	8,179	3.96	2,990	4.36	1,360
16	.....	.....	2.90	1,885	5.73	8,562	2.94	6,903	4.18	2,494
17	.....	.....	.....	.....	4.78	7,895	3.12	10,460	4.63	2,721
18	.....	.....	3.32	1,417	.....	.....	.....	.....	.....	.....
20	1.98	340	2.84	3,685	4.72	17,647	4.43	13,302	2.97	10,432
21	..	.....	3.03	666	5.30	213	4.84	2,380	3.25	3,387
23	.....	.....	2.74	936	5.59	1,602	5.20	2,267	3.38	1,984
24	.....	.....	.....	.....	9.88	128	.....	.....	.....	.....
25	.....	.....	.....	.....	.....	.....	5.33	1,374	3.66	2,055
28	.....	.....	.....	.....	.....	.....	.....	.....	4.18	141
Total wt. of sap	...	538	....	15,662	.....	77,863	.....	63,269	.....	34,861
Average sucrose	2.33	.....	2.72	.....	5.01	.....	3.66	.....	3.42	.....

Date.	Number 6.		Number 7.		Number 8.		Number 9.		Number 10.	
	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.
	P. ct.	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*
April 7	.....	.....	.....	.....	...	.....	.....	.....	.....	.....
8	3.23	1,729	3.93	439	3.27	2,963	....	.....	4.30	382
10	.....	.....	.....	.....	3.55	2,637	.....	.....	.....	.....
11	.....	.....	6.41	1,091	4.39	524	.....	.....	4.50	694
13	3.16	9,241	3.45	2,253	2.69	11,709	3.99	85	4.10	3,331
14	3.19	1,871	3.44	963	3.09	3,657	.....	.....	3.63	1,586
15	2 90	9,979	3.55	935	3.02	2,991	.....	.....	.....	.....
16	4.78	1,601	3.39	1,133	2.85	3,956	.....	.....	.....	.....
17	3.89	3,019	.....	.....	2.87	2,467	.....	.....	3.17	2,210
18	.....	.....	4.10	1,133	2.93	2,904	.....	.....	.....	.....
20	3.03	9,979	3.15	3,231	2.91	4,138	3.62	212	3.05	4,818
21	2.91	6,647	3.76	240	.....	.....	.....	.....	3.66	453
23	3.04	3,288	3.98	212	2.71	368	.....	.....	3.58	1,077
24	.....	.....	....	.....	.....	.....	.....	.....	.....	.....
25	3.20	2,749	.....	.....	....	.....	.....	.....	.....	.....
28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total wt. of sap.	.....	50,103	.....	11,630	.....	38,314	.....	297	.....	14,551
Average sucrose	3.15	.....	3.74	.....	2.98	.....	3.73	.....	3.53	.....

TABLE I.—*Percentage of sucrose and weights of sap*—Continued.

Date.	Number 11.		Number 12.		Number 13.		Number 14.		Number 15.	
	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.	Sucrose.	Weight of sap.
April 7	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*	*P ct.*	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*
8	.....	....	.....	....	.....	....	.....	....	.....	....
10	5.14	866	2.03	2,538	2.84	326	2.67	539	3.11	679
11	5.47	510	.....	....	.....	....	.....	....	.....	....
12	2.98	213	4.26	965	2.51	269	6.04	539	3.69	1,488
13	4.75	2,906	4.03	3,430	4.85	510	6.17	1,885	3.58	2,807
14	4.59	1,361	†4.26	2,083	4.57	397	6.06	454	3.24	992
15	4.37	1,347	4.15	1,374	3.18	567	3.46	1,427	3.17	964
16	4.16	1,744	3.32	2,197	3.97	298	2.90	1,899	2.66	1,361
17	3.90	1,646	3.18	2,126	4.13	553	.....	....	2.91	510
18	4.08	1,885	.....	....	.....	....	.....	....	.....	....
20	4.17	3,827	3.32	4,390	3.34	1,063	10.20	227	2.68	2,027
21	.....	....	4.35	737	3.63	184	.....	....	.....	....
23	4.68	....	3.46	950	3.21	170	3.68	2,381	.....	....
24	.....	....	.....	....	.....	....	.....	....	.....	....
25	.....	....	.....	....	.....	....	.....	....	.....	....
28	.....	....	.....	....	.....	....	.....	....	.....	....
Total wt. of sap.	.....	16,475	.....	20,790	.....	4,337	.....	9,351	.....	10,828
Average sucrose	3.75	....	3.55	....	3.69	....	4.36	....	3.18	....

*Analysis of sap from one tap only.

†Analysis of sap from lower two taps.

The specific gravity of the saps taken by the hydrometer at 62° F. generally ranges between 1.010 and 1.020; where the percentage of sugar reached 5 or 6 per cent. the specific gravity would reach 1.025. The mean specific gravity is nearly 1.015.

The variations in the content of sugar in the saps of each tree are greater than would have been expected. In most cases, however, it will be seen that a notable increase in the content of sugar is accompanied by a decrease in the quantity of sap.

The highest percentages of sucrose are found in tree No. 3, April 24. viz, 9.88 per cent., and in tree No. 14, April 20, viz, 10.20 per cent. In both these cases it will be noticed that the flow of sap was small, being 128 and 227 grams, respectively.

The study of the sap from such a tree as No. 3 offers also the interesting suggestion that it may be quite possible to increase the percentage of sugar in the sap of future maples by planting the seed of such trees as show the largest percentage of sucrose. There are large areas in all the Northern States unsuitable for tillage but well adapted to the growth of maple forests. If such forests are not planted too thick the ground will afford good pasturage, while, after a quarter of a century, the trees will yield large quantities of sugar. In planting such forests it will be wise to take the seed from trees with the best pedigree. There is every reason to believe that a race of maples, yielding a large percentage of sugar, could be developed as easily as a race of cows, yielding large quantities of butter.

Among the maples there may yet be a race of Jerseys.

ALBUMINOIDS.

To determine albuminoids 10 cubic centimeters of the sap were evaporated to dryness, and burned with soda-lime. $\frac{N}{100}$ soda and acid were used for titration.

The following are the results obtained :

Per cent of albuminoids.

Date.	No. 3.		No. 4.		No. 8.	No. 11
	E.	W.	N.	S.		
April 8	.....	....	.....	......	.0119	......
11	......	.0138	.....	.....	.0206	.0219
13	......	.0319	.0144	.....	.0219	.0225
14	.0069	.0188	.0244	.0263	.0206	.0294
15, 12 m	.0094	.0269	.0112	.0300	.0275	......
15, 3 p m	......	......	.....	....	.0044	.0200
15, 6 p m	......	......	......	.....	.0219	.0231
16	......	......	.....	.....	.....	......
23	......	.0300	.....	.....	.0469	.....
Mean	.0081	.0163	.0180	.0272	.0202	.0242

The albumen was also estimated in sap taken on the 17th, from the groves of Messrs. Stewart and Smith. In Mr. Stewart's grove of 700 trees the percentage was .0088 ; in Mr. Smith's grove of 1,500 trees it was .0103.

OTHER CONSTITUENTS.

All the early saps were tested for starch, but in every case with negative results.

All tests for reducing sugar in the early saps in the fresh state failed to reveal its presence. As the season advanced, however, it was present in increasing quantity. Eight determinations made in saps collected on the 23d give a mean of .256 per cent., but casting three especially thick saps the average is cut down to .057 per cent.

Most of the samples were titrated with $\frac{N}{100}$ soda, to determine the amount of acid, which was calculated as malic acid.

The maximum amount in a fresh juice rarely reached .005 per cent., and more frequently fell to .0005 per cent. The clearest saps frequently contained the most acid.

The mean of 25 determinations of solids gives a purity coefficient of 95.0 ; and the mean 22 ash determinations is .146 per cent.

The thick viscous sap which occurs late in the season, or when a sap is allowed to stand for any length of time exposed to a warm atmosphere, gives a slight precipitate of gum upon the addition of an equal volume of strong alcohol, which does not occur with the earlier saps.

Analyses of saps taken from different sides of the tree.

Date.	Tree No. 3.				Tree No. 4.			
	East.		West.		North.		South.	
	Sucrose	Weight of sap.	Sucrose	Weight of sap.	Sucrose	Weight of sap.	Sucrose	Weight of sap.
	Per ct.	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*
April 7	....	2,977	5.80	1,616	....	....	....	....
8	....	....	....	....	3.23	2,155	4.56	1,658
11	6.23	2,169	3.69	1,063	5.11	170	4.43	1,970
13	....	9,299	5.40	6,988	3.87	3,544	4.36	5,542
14	5.14	5,585	5.35	3,940	3.03	2,665	2.96	6 889
15	4.88	5,542	5.44	2,637	3.07	609	4.19	2,381
16	4.53	5,897	5.17	2,665	....	....	2.94	6,903
17	4.69	4,747	4.92	2,948	3.27	3,416	3.06	7,044
20	4.78	9,355	4.66	8 292	4.65	6,406	4.20	5,896
21	5.30	2,130	....	....	5.16	1,360	4.41	1,020
23	6.15	1,035	4.56	5,067	5.46	1,530	4.67	737
24	....	Dry.	9.88	128	5.33	1,374	....	Dry.
25	....	....	....	....	....	....	....	....
Total weight of sap	....	47,019	....	30,884	....	23,229	....	40,040
Mean per cent of sucrose	4.93	....	5.10	....	4.10	....	3.41	....

In tree No. 3 the west side seems to afford a slightly richer sap, but it will be seen that the flow was not so abundant as from the east side. In No. 4 the same is true of the north side.

Analysis of saps taken from taps at different heights.—Tree No. 12.

Date.	1.		2.		3.		4.	
	Sucrose	Sap.	Sucrose	Sap.	Sucrose	Sap.	Sucrose	Sap.
	Per ct	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*
April 8	2.95	780	2.22	496	1.93	312	1.22	950
11	3.91	298	5.17	142	5.21	156	3.78	369
13	3.54	1,120	3.85	893	3.88	652	5.08	765
14	4.03	680	4.57	510	....	397	....	496
15	4.16	312	4.20	439	4.31	340	3.90	283
16	2.74	751	3.47	595	3.82	454	3.61	397
17	2.77	822	3.43	1,304	....	....	....	....
20	2.72	1,488	3.44	1,215	3.77	950	.81	737
21	4.05	524	5.08	213	....	....	....	....
23	3.11	780	5.06	170	....	....	....	....
Total weight of sap	....	7,555	....	5,977	....	3,261	....	3,997
Mean per cent of sucrose	3.23	....	3.70	....	3.29	....	2.96	....

From this it is seen that the sap from various parts of the trunk varies in composition, but not regularly in proportion to distance above the ground. Thus in the above experiment the best sap was found at a distance of 5 feet above the ground, while the poorest was taken at a height of 11 feet. Further experiments will be necessary to determine the influence of altitude of tap on the composition of the sap

Analyses of saps taken from the same trees at different times of day.

Date.	9 a. m.				12 m.			
	No. 8.		No. 11.		No. 8.		No. 11.	
	Sucrose	Weight of sap.	Sucrose	Weight of sap.	Sucrose	Weight of sap.	Sucrose	Weight of sap.
	Per ct.	*Grams.*	*Per ct*	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*
April 15	....	....	....	....	2.96	1,687	4.40	780
16	....	....	....	... .	2.62	1,588	4.07	950
17	2.69	1,191	4.27	808	2.96	794	2.97	498
18	....	....	....	....	2.86	1,884	4.21	1,205
20	....	....	....	....	2.99	595	4.18	595
Total weight of sap	....	1,191	....	808	.... ..	6,548	....	4,028
Mean per cent of sugar	2.69	... ...	4.27	....	2.88	....	4.06	....

Date.	3. p. m.				6 p. m.			
	No. 8.		No. 11.		No. 8.		No. 11.	
	Sucrose	Weight of sap.	Sucrose	Weight of sap.	Sucrose	Weight of sap.	Sucrose	Weight of sap.
	Per ct.	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*
April 15	3.10	964	4.31	411	3.12	340	4.38	156
16	3.05	1,503	4.18	496	2.93	865	4.43	298
17	3.18	482	4.40	340	....	......	....	....
18	3.06	1,020	3.86	680	....	....	....	....
20	3.27	340	4.27	369	....	....	....	....
Total weight of sap	....	4,309	......	2,296	....	1,205	....	454
Mean per cent. of sugar	3.07	....	4.16	....	2.98	....	4.42	....

The above results are also negative. In tree No. 8 it appears that the maximum richness of the sap was in the sample taken at 3 p. m., while in No. 11 it was found in the sample taken at 6 p. m. In all the above cases, except those of April 20, 12 m., it must be remembered that the sample taken at any given time included the whole product of the tree from the time the immediately preceding sample was taken; in the exceptional case, the sap taken was the product of the flow from 9 a. m. of that day.

Total quantities of sap and sugar from each tree.

Number.	Weight of sap.	Mean per cent of sucrose.	Weight of sugar.
	Grams.		*Grams.*
1	538	2.33	12.51
2	15,662	2.72	438.66
3	77,863	5.01	3,939.75
4	63,269	3.66	2,317.93
5	34,168	3.42	1,169.22
6	50,103	3.15	1,579.28
7	11,630	3.74	434.33
8	38,314	2.98	1,141.40
9	297	3.73	11.06
10	14,551	3.53	513.94
11	16,475	3.75	617.05
12	20,790	3.55	738.36
13	4,337	3.69	160.22
14	9,351	4.36	408.06
15	10,825	3.18	344.48
Mean, omitting 1 and 9	28,257	3.75	1,061.59

The average yield of sugar to the tree varies much in different seasons. It is usually stated as two to three pounds. Large trees have yielded, however, as high as forty pounds, and quite a number are known to have yielded twenty pounds in a single season. The usual quantity of sap required for a pound of sugar is sixteen quarts, but Mr. Wheeler mentions a tree which yields a pound for every five quarts. This year Mr. Porter Smith of Lunenburgh made about 3,000 pounds from 1,500 trees; Mr. Hosea Thomas, 1,000 pounds from 500 trees. though in some seasons he makes twice that quantity. Mr. Chester Thomas made about three pounds to the tree, whereas he has made as much as five to six pounds, in very favorable seasons. The product this year would seem to be on the average two to two and a half pounds.

AVERAGE YIELD FROM GROVES.

In order to determine the average percentage of sugar from a large number of trees, samples were collected from the storage-tanks of different sugar-makers in town.

No. 1. From camp of H. Day, who has 250 trees, largely old-growth rock maple, on a low, moist piece of ground. Sample taken on the 9th.

No. 2. Taken on the same date, from the camp of V. E. Hartshorne, adjoining that of H. Day, and of similar character. Taps 300 trees.

No. 3. Taken on the same date. from the camp of Harrison Stowell, which lies high on a hillside, with eastern aspect, and is composed largely of second-growth trees, with a good proportion of white maple. Taps 500 trees.

No. 4. From the camp of Wesley Stewart, which lies on a gentle slope with boggy ground, and contains mainly second-growth trees, and a good proportion of white maples. Taps 700 trees. Taken on the 17th.

No. 5. Sample taken on the same date, from the camp of Porter Smith, which lies on the same side of the ridge with that of H. Stowell, and is similar in make-up. Taps 1,500 trees.

No. 6. Taken on the 22d, from the camp of F. Luce, on a gentle slope with southern aspect. All good-sized second-growth, with many white maples.

Average yield of large number of trees.

Sample number.	Date.	Number of trees.	Per cent sucrose.
1	April 9	250	3.37
2	9	300	3.71
3	9	500	2.93
4	17	700	3.85
5	17	1,500	3.07
6	22	300	2.39
Total		3,350	3.25

MANUFACTURING NOTES.

The trees are tapped as soon as the sap will flow; $\frac{3}{8}$-inch to $\frac{5}{8}$-inch bits are used, and borings made to the depth of 1 to $1\frac{1}{2}$ inches, preferably near the ground and on the southern and eastern sides. Trees under 7 or 8 inches diameter are not tapped. Spouts of tin, galvanized iron, or seasoned wood, are driven in so as to be supported by the bark. The metal spouts are best because they hold the pail on the depending hook, in the absence of which a nail must be used. Painted wooden pails are often used, but the tin pails are growing in favor, being lighter, more readily cleaned, and more durable. Covers for the sap-pails have been invented, but have not as yet come into general use.

The sap is collected as frequently as possible, by hand or in a draw tub of tin or wood securely fastened to a sled. Before being placed in the storage-tank it must be freed from impurities by straining or settling. Draw-tubs and storage-tanks of tin are highly recommended. When the sap is dark colored, or thick, as at the end of the season, it should be kept separate, and can often be used for making vinegar. Sap must not be allowed to stand in storage-tanks longer than is absolutely necessary, and must not be kept in a warm place, since it spoils rapidly.

Kettles are used only by careless makers. The best use evaporators, or Russia iron pans, $5 \times 2\frac{1}{2} \times \frac{8}{12}$ feet in dimension; they are set on brick arches, which are 20 inches in depth, and made with an ash and air space below. A great many use the heater—a copper box with three or four large, or twenty or thirty small tubes passing through it, and with a funnel-shaped tin top provided with overflow tubes. The heaters are placed behind the pans, and the waste heat passing through the tubes is utilized. The sap always boils violently on each fresh addition, and overflows into the adjoining pan. The best makers are discarding the "heater" because the violent ebullition prevents skimming immediately after the addition of cold sap. There is little change in specific gravity effected in the heater. A few use evaporators, or pans so arranged that the sap flows in continuously at one end and comes out at the other as sirup. As they are more expensive and require more care than the pans, they are not very much used.

The fuel used consists of soft-wood, trimmings of the grove, spruce, and hemlock brush, or saw-mill edgings. The usual quantity required is 1 to $1\frac{1}{4}$ cords for each one hundred pounds of sugar.

To produce a light colored sirup, quick boiling and thorough skimming are necessary. A few use milk or white of egg for raising the scum, but it is apt to diminish the clearness of the sirup; the best makers add sap little by little, and skim immediately after each addition, most of the impurities coming at once to the surface.

The scum is generally of a very dark color, and sometimes contains as much as .37 per cent. of albuminoids.

When the sirup has reached the desired consistency it is run out of the pan and filtered, while hot, through flannel.

If the product desired is sugar it should be made directly from the sap, for the sirup darkens and loses flavor on standing. Chester

Thomas, of Lunenburg, Vt., who has gained a wide reputation by his light-colored sirups and sugars, says that he always runs the boiling sirup down into sugar as soon as it reaches a slight straw color, no matter how small the quantity. When the boiling is completed the pan is removed and the sirup stirred while cooling to give a lighter color and a smoother grain to the sugar. Molded and stirred sugar requires more boiling, and consequently more care to avoid scorching.

The usual test for the completion of the boiling is the attainment of a given consistency, which varies with each maker, as the hydrometer is rarely if ever used. Mr. Whitcomb, of Enosburg, Vt., mentions the following temperatures as indicative of the degree of concentration for sugar and sirup: Sirup, 220° to 222° F.; tub-sugar, 228° to 232° F.; cake-sugar, 245° F.; stirred sugar, 252° F. The thermometer is, however, not often used.

A source of great annoyance to many sugar-makers is found in the so-called "sand" or "niter," which forms a non-conducting layer on the pans, deteriorates the appearance of the sirup by separating out, on standing, in dirty-looking flocks, and gives an unpleasant grittiness to the sugar. The deposition is said to occur only at a density of 28° to 32° of the saccharometer. If the coating is burned on the pan it is very difficult to remove, hence the pans should be scraped clean every day. While early analyses seem to conflict as to the composition of this substance, all recent investigations prove it to be invariably an impure acid malate of lime.

Its occurrence to a troubelsome extent is very variable, and no satisfactory explanation of its variation has yet been found. Most observers agree that it occurs in greatest quantity after an open winter, or in seasons when the sap is sweetest, and that groves on low mucky soil are more affected than those on high, dry land.

In Northern Vermont the sirups are sent to market in large tin cans. The greatest demand is for tub-sugar, which is poured, while warm, into tin or wooden vessels of about 28 pounds capacity. Occasionally a little sugar is made into 4-pound, 2-pound, and ¼-pound cakes, but there is little demand in the markets supplied by Essex County for sugar in this shape.

Mr. Wheeler estimates that the cost of manufacture is between 6 and 7 cents per pound. As good sugar in bulk brings 10 and 12 cents per pound, and good sirup $1 and $1.25 per gallon, it would seem that the business is quite profitable, especially since it occurs at a time when little work can be done on the farm.

PRESENT DEMAND.

The demand from the market changes from year to year. Ten years ago and earlier stirred sugars were in best demand; then tubs and caked sugar; now sugar in tin pails and air tight tin cans. What the next fashion will be no one can tell. It is best to put it up in such a way as to command the quickest sales and fullest prices.

FURTHER EXPERIMENTS.

Believing there might be a difference in years as to the sweetness of sap some of the same trees were experimented upon as last year, but no special difference was found. Those sweetest last year yielded the largest per cent. of sugar this year. Those that showed a difference in the per cent. on opposite sides, persisted in the same peculiarities this year, so we have no new developments to record.

Further experiments upon tappings above each other in different parts of the states, show that in general the tappings upon the trunk are best in quantity and quality near the ground, but there are exceptions in relation to sweetness oftener than in amount. Further experiments seem to confirm the previous opinions that the sap is sweeter from the branches, but small in amount. We trust any peculiar conditions will be reported to us each year, that all light possible may be thrown upon the subject.

EXPERIMENTAL FARM WORK.

But a few years ago, much was expected from the experimental work on the plot system, from the various experimental farms and stations in the United States, and the Connecticut station and some others conducted many experiments of that kind. They were to their own advantage and to the advantage of those that assisted them in various parts of New England; but when the results obtained were made use of by others, it was found that a new series of tests and plot experiments must be made by every farmer, to make the advantages gained, most useful to them. The reason was that soils so differed in their composition and in their requirements, in consequence, to produce a good crop. It seemed it was for the experimental stations to promulgate the principles and for the farmers to work out the problems, or final results, upon their own farms, to reap the benefits. The state of North Carolina in their late action spoke the facts, and all should profit thereby.

Their action was as follows:

"Voted, that the board shall refrain from ordering any field tests to be made *at the Station*, for the following reasons:

1st. These experiments are very expensive.

2d. They need to be conducted through a series of successive years to be worth anything.

3d. Owing to the extreme diversity of soils in this State, most results obtained would only benefit those farmers who lived near the station or had soils of similar character to ours.

As a means of education, these model farms and field experiments are useful, and as hints to others they are valuable. and yet their worth is greatly overestimated when made at stations, and underestimated when made by the farmers themselves."

This fully represents the facts, as such tests when made upon the farm are a sure highway to success, and we have found them valuable much beyond their cost; hence shall give you some of the results of twenty years experiments, that all may reap the reward of such labor, if they will but act. The farmers must know their farms and their capabilities as much as the logmen must know the capabilities of their teams that haul their lumber.

No guess work will be profitable, but the sure results from known causes.

To illustrate this we will give some experimental work of ourselves and others, to mark the way whereby farmers can find the landmarks of success; though we well understand the unbelieving traits of the mind of man, that are so obstinate that to change our habits of cultivating the soil, requires, not only facts in argument, but facts seen under their own hand and even then many will say, that they know there are great profits on a single acre thus managed, but no man could make such a profit on his whole farm ; as though a hundred acres of corn would decrease the price of the product, or could never find purchasers.

In the improvement of land you also increase the actual value, as well as the profit from increased crops, hence it is a double advantage.

Allow us to illustrate by a simple case in our experiments. We purchased eight acres of land said to be worn out and nearly worthless. Four acres we plowed and thought to restore it in the usual way, while four acres were made the subject of a top dressing experiment. One acre was, after being harrowed and seeded as it all was ; top-dressed in winter. The product the ensuing year was two and a half tons. Next acre top-dressed in spring, with a product of one and one-half tons ; another acre top-dressed in June and eight hundred and sixty pounds the result. One acre not top-dressed and four hundred and ninety pounds of product. The cost of the fertilizer and the time spent were equal on each acre. Now, our neighbors saw this experiment and talked about the advantages of winter manuring, but we are not aware that but one or two have since practiced it ; though for four years this field spoke in eloquent language for the new departure. We learned in that a lesson of great value and have since adopted the new time ; we truly believe with great benefit. Anyway our crops are heavier than others produce around us, at a much less outlay. This was a result from a moderate supply of stable manure and ten bushels of ashes to the acre ; yet we have other land that the ashes will not benefit. But how are we to know? We ascertain all by asking of the plant we cultivate, what is required? When the question has been fully answered through the plot system we understand the requirements of the soil and then act upon the facts learned. We generally make the plots long and narrow with a space of unfertilized land between ; in size according to circumstances, but a certain fraction of an acre that the results may be easily ascertained.

MANURE.

Manure to the farmer is a precious thing. It either costs us money outright or else much labor, cattle-food, and care, in an abundant measure. For such a valuable and costly thing we should use every care in its bestowal and have the soil as far as possible adapted to its reception.

It is easy to throw manure away, or to squander it upon ill-conditioned land and we believe the great want of Vermont farmers not so much, more manure, as the right and judicious use of what we have.

Yet we must have it and before we start out with our experiments it will be well for us to consider from what sources our supply is to come. We must have the food for the plant before we can have our crop. With that object in view let us look at the great waste of night-soil.

"Waring," in his book for young farmers, remarks that "night-soil, or human excrement, is the best manure within reach of the farmer." And so evidence might be accumulated upon that point from every one who has ever carefully husbanded and properly applied this substance as a fertilizer. It has been estimated that the night-soil of England in the course of a single year is equivalent to 5,000,000 tons of the best guano. Allowing an average of 500 pounds of solid and liquid excrements to each individual in the United States, and the population to be 50,000,000, we have 12,500,000 tons of this fertilizing substance; and allowing guano to be twenty times as valuable as the combined solid and liquid excrements, we should then have fertilizing matter equivalent to 625,000 tons of guano; but the population of the United States being about twice as great as that of England, with the same proportionate estimate as for that country the value of our excrement would be equivalent to 12,500,000 tons of the best guano; even taking our moderate estimate, and we are fully satisfied that by its full return to the soil, a great advantage would be derived.

In China the law forbids that any human excrement, or urine, should be thrown away and reservoirs are constructed in every house where all is deposited, composted and deodorized, with the greatest care. Says Liebig: "If we admit that the liquid and solid excrements of man amount on an average to 547 pounds in a year, which contains 16.41 pounds of nitrogen, this is much more than is necessary to add to an acre of land in order to obtain with the assistance of the nitrogen derived from the atmosphere, the richest possible crop every year." Think of this, you men who have families consisting of six or eight persons; fertilizing in the best possible manner as many acres, when in all probability, the same is at present but poorly applied, if employed at all.

If the fact be so, is it not a proper subject for consideration? Let each farmer resolve, that in the future,as far as lies in his power, he will endeavor properly to save and economically use all the excrement of the family, both solid and fluid, and what wealth will be added to our small commonwealth.

In an essay upon manures published in the Iowa Agricultural Report for 1882 is found this language; "The economic relations of night-soil, is one of the most important questions that demands the attention of the agriculturist, and not until its importance is fully appreciated, will the exhausted lands of the east regain their lost fertility, and the steady impoverishment of our western prairies cease." If the saving and use of human excrement is the wonderful alchemy by which the reputed deteriorated soils of New England are to be restored to their original fertility, much gratitude ought to be felt, and expressed too, towards those individuals who by experiment or otherwise have discovered its great value.

But like any other thing of great value, it must be cared for and as the concentration is such, it must be diluted and then put on *thin*.

Many condemn, on account of heedless application. But the dry earth method removes all trouble.

W. H. Yeomans says: "Some years since we tried that method, by filling, at the commencement of winter, a barrel with coal dust, upon which urine was poured until the same was thoroughly saturated and frozen solid, when it was abandoned. In the spring the same was used to plant corn, by putting about one pint in the hill, dropping the corn directly upon it. The result was that hardly a spire of corn made its appearance; it had been as thoroughly killed as it would have been with the same amount of the best guano. The piece was planted over, however, by striking into the hill with a hoe, dropping in the corn, and again covering. This time the corn came up, grew vigorously, and maintained throughout the season the darkest and richest color of any corn we ever saw. This satisfied us as to the great value of urine as a fertilizer. The past season we tried chip-dirt, saturated in this manner, side by side with superphosphate, with very nearly equal applications in quantity and could discover no appreciable difference in the growth of the corn or in the general result. Of the two, that where the urine was used, as in the previous case, was of a deeper and richer color while growing. We have for several years used this material almost wholly in the garden, and sometimes upon vines in the field, and always with success.

Now if these substances, as we believe has been proven, do possess such valuable fertilizing properties, and have in the past been generally discarded, and allowed to go to waste, is it not high time that an economical use be made of them, and so the alleged deterioration of our soils not only be arrested, but the same in a great measure be restored? Is not this better than to make such excessive expenditures for manures and commercial fertilizers as are now made? This is a subject of the greatest importance to the farmer, and should receive his careful consideration.

A gentleman who has practiced this to some extent remarked in our hearing that in that way in the course of the year, he could make from fifteen to twenty barrels of fertilizer, that he had rather have, barrel for barrel, than superphosphate.

Jonathan Lawrence stated at one of the meetings of our board of Agriculture, that the waste from the kitchen and the contents of the water-closet, if properly composted would be of greater value to our state than all the commercial fertilizers sold therein to farmers, thus saving at least one and one half million of dollars annually.

HOW TO COMPOST IT.

First a plenty of dry earth, or dry muck is needed and a compost-building, which all farmers should have. This building need be only a shed of sufficient size and may have a plank or hard earth floor. In it should be stored dry earth, muck, agricultural salt, kainit, bone meal, land plaster, etc. A large box of dry earth should stand in the privy, in the same a convenient hand shovel; beneath the privy should be a water tight vault, and all persons using it should sift into this vault a sufficient amount of dry earth to prevent all odor.

If there is any odor remaining pulverized sulphate of iron (copperas) should be sprinkled in until it is entirely removed. Once a week the contents of this vault should be removed to the compost-shed and mixed with dry earth, or muck, until it is dry and fine, when it may be placed in a heap for use. A barrel of dry earth should be placed where it is convenient to empty the urine from the house upon it and as soon as such barrel is saturated it should be composted as before stated. The refuse from the sink should also be carried in drain pipes to the compost-house, received in a vat there and composted as the other; yet if the amount is too large it can often be utilized as well and more cheaply, by running the same out into the field and composting with muck at the end of the drain. In this way if not so perfectly cared for, there is no disagreeable smell from it, as in the compost-shed, yet all such smells may be prevented by the use of salt, sulphate of iron, kainit, etc. Care must be taken with these composts that they be not used too abundantly. As a rule they are as valuable barrel, for barrel, as superphosphate of lime.

HEN MANURE.

This is another valuable source of fertilizer and can be composted as before described, or the floor of the hen-house can be covered with a layer of muck, sand and earth, in which there is a sprinkling of bone meal, rather coarsely ground and the hens will compost it themselves very nicely. A barrel of this material for every five hens is about the right amount of compost.

OUR STABLES.

First, our stables should be kept sweet. Those odors are due, at least in part, to the escape of nitrogenous products of decomposition of the manure, and indicate a partial loss of this valuable plant food. What is much needed is a disinfectant that will prevent this loss, that may, if possible, add valuable fertilizing salts to the manure, and that shall be reasonable in cost and easy of application. None of the ordinary disinfectants answer all the requirements. Carbolic acid is little more than a deodorizer. Chloride of lime is powerful, but the chlorine gas is disagreeable, and if too strong is unhealthy. Sulphate of iron is very soluble and a good disinfectant, but the manure does not require so much iron. These three are the most common, but they are expensive and add little to the fertilizing value of the manure. They have not, therefore, been adopted to any great extent for stable disinfection. Plaster is cheap, but being very insoluble it is not an efficient disinfectant. Lime aids in the decomposition of animal and vegetable matters; it also purifies, but has no power to hold the ammonia, which is therefore lost as fast as generated.

The German kainit seems to meet all the requirements mentioned. It contains about 22 per cent. of sulphate of potash, with sulphate of magnesia, chloride of soda and chloride of magnesia. It is soluble in less than thrice its weight of water, and therefore easily put into the most effective form for use. Besides adding potash to the soil, the sulphuric acid of its sulphate of magnesia, like the sulphuric acid of the sulphate of lime in plaster, appears from the experiments of Birner & Brimmer to unite with the ammonia, as it is formed by the decomposition of the manure, to make the non-volatile sulphate; but more than that the kainit appears to have another valuable quality of holding the ammonia in the manure. Prof. L. H. Armstrong and others say, of gathering it, also, from the atmosphere. To show the action of kainit and other substances on manure, and the possibility of its gathering ammonia, I will briefly summarize the valuable experiments of the gentlemen above named on horse and cow dung. Portions of this mixture were subjected for a year to the action of lime, plaster, sulphate of magnesia and kainit. The results were that 1 per cent. of lime caused a loss of 9.78 per cent. of the nitrogen of the dung. 1 per cent. of plaster resulted in a loss of only 0.34 per cent. of the nitrogen; 1 per cent. of sulphate of magnesia saved all of the nitrogen that was in the dung and attracted an addition of 5.06 per cent. of the nitrogen already there; lastly, 1 per cent. of kainit saved all of the nitrogen and added 7.97 per cent. of its own amount to it. One pound of kainit per day scattered in the stalls is sufficient for each animal. Probably it would be more effective if dissolved and applied with a watering-pot, using a quart or less per day of a saturated solution for each animal, in small sprinklings, as occasion required. The cost of kainit in the city will be $10 or less per ton—half a cent a pound, with freight added to where you reside. It will nowhere cost more than one cent, which will be a trifling cost per day for each animal. If farmers would use kainit freely in cow and horse stables, muck and compost heaps, pig-pens and chicken-houses, privy, sinks and cesspools, by its purifying powers in these appurtenances, almost always too near the dwelling, they would greatly promote comfort and lessen the mortality in their families. which is now up to the full average despite their country life. It will be proper to remark that when kainit is used in manure and composts, thus fixing and increasing the nitrogen and enriching them with potash, etc., and in no way correspondingly increasing the phosphoric acid, it would be wise for the farmer to add a proportionate quantity of some material containing that indispensable ingredient, in order to make the manure a complete and well-balanced fertilizer, for though it may be rich in nitrogen and potash, a deficiency of phosphoric acid will in the end be equivalent to a deficiency of the other two great elements. Bone meal mixed in the manure and compost heaps will decompose evenly with the other matters. If not so used superphosphate will be the material to apply directly to the crops. We, however, believe a judicious use of bone meal and composting, will prevent the necessity on most land for a superphosphate.

COMPOSTING STABLE MANURES.

Years ago it was supposed that some crops could be raised only by the use of well rotted manure, but of late composted manures have taken its place largely and often to great advantage. Barn cellars were at one time supposed to be almost a necessity, but we believe the compost-shed and winter manuring should supplant them. At least no one will to-day doubt that absorbents in the stable sufficient to hold all the liquids, not only desirable, but almost indispensable. Often by the combination of different ingredients we get a less expensive and possibly better fertilizer, and with that intent, composting, has to many, become a valuable auxiliary in farm cultivation. We will therefore look into the subject to some extent and see if we can gain an idea of its worth from observation

ANALYSES OF STABLE AND YARD MANURE.

	1.		2.		3.	
	FRESH HORSE MANURE.		FRESH COW MANURE.		OLD YARD MANURE.	
Water		75.76		85.30		54.70
Organic and Volatile matters		19.17		12.66		10.87
Containing Nitrogen:—As Volatile Ammonia Salts	0.22		0.06		0.01	
As Fixed Ammonia Salts	0.04		0.01		0.02	
In other combination	0.27		0.31		0.43	
Total Nitrogen	0.53		0.38		0:46	
Ash, containing:—Potash	0.51	5.07	0.36	2.04	0.16	34.43
Soda	0.09		0.04		0.07	
Lime	0 30		0.29		0.47	
Magnesia	0.19		0.19		0.50	
Oxides of Iron and Alumina	0.19		0.09		2.00	
Sulphuric Acid	0.09		0.04		0.01	
Phosphoric Acid	0.41		0.16		0.72	
Chlorine	0.07		0.07		trace	
Sand, Clay, and insoluble matters	3.22		0.80		30 50	
		100.00		100.00		100.00
Weight per cubic foot		35 lbs.		63 lbs.		40 lbs.

and practice. As a starting point we will give you an analysis made by Prof. Johnson of Connecticut, of three grades of manure.

First. Fresh horse manure, where the horses were fed upon oats. corn meal and hay, probably cut hay mostly, the bedding litter going in as an absorbent.

Second. From the stable where cows were fed on hay, with a daily allowance of four quarts of wheat bran, and four quarts of mangolds, no absorbent used.

Third. Well rotted manure from yard where young cattle were kept, fed on hay. The manure, as usual, was heaped in the spring and rotted through the summer. [See p. 310.]

Now much depends upon the condition of the manure in the soil; you will notice the greatly increased weight of No. 2. Now if this had been taken to a compost-shed (having first had an absorbent used in the the trench behind the cows, so that no urine could be lost), and then composted with muck having some potash and possibly bone dust added, it would have become more valuable.

First, on account of the pulverizing of the material.

Secondly, by the value of the additions, and having first ascertained as we have before mentioned the needs of your farm by experiment, you are enabled to make just the provision you desire, as will be seen by and by. But we will consider composting further in regard to what we wish to accomplish. Should we desire to keep all the fertilizing material in the manure intact for a given length of time, say one year, and not only have it equally available when used, but in addition gather more plant food for our crop, we could use crude kieserite, or instead

LAND PLASTER (SULPHATE OF LIME).

This is not in itself plant food, but has remarkable powers as a deodorizer, also as a preservative to prevent manure from changing or heating. But plaster is not of use on all land, still by making repeated applications and carefully observing the effects, you can settle the question whether plaster is a good, indifferent, or bad fertilizer for your land. It may be good for you, and another farmer may find that it is of no use to him. There are statements made and recorded in all seriousness, that plaster is a damage to land. Only when we ascertain *how* plaster works can we reconcile these opposing and conflicting statements. We already know something about the mode of action of plaster, something that has been taught us by the chemist, who alone has the lever which will open this mystery. A French chemist, Monsieur Deherain, who made the earliest investigations on this subject, (Baron Liebig also studied the matter about the same time), collected a number of soils, which in practice were highly benefited by plaster, and a number of others which were not helped by its use. He put each of these soils in contact with water, to which he added, in each case, the same quantity of plaster, shook them well and frequently together, and allowed the water and plaster to act upon the soil. Then he took off a portion of the water from each soil and analyzed it chemically. He found that in all cases the plaster had liberated some potash and some magnesia from the soil, beyond what pure water could take up; but he found that those soils which were largely benefited by plaster were those in which this liberation was very considerable, while those not benefited by plaster in practice were those in which this solvent action of plaster was very slight. This is not all the action of plaster, but it is one of its effects. An essential part of agriculture is to liberate the potash in the soil, and make it available for our crops. Every crop must have potash. You cannot make an atom of starch in the potato, wheat, or any other plant, nor can you grow a plant of any kind whatever unless potash assists in that operation. This most important fact has been proved by some very delicate experiments made quite recently at one of the German agricultural experiment stations. We are now in a position to assert with confidence that we know that without potash we cannot accomplish the production of starch, which is the chief food element in our grains and vegetables. We know that plaster makes potash available to plants in many cases where it would otherwise be deficient. We know further that some soils do not contain potash in such a condition that plaster can liberate it for crops. But if our land does so contain it we are much benefited by such liberation, yet this is only one of the ways in which it may be available, but it is the one that aids us most. In case it aids us we should use plaster in our compost, as well as what else we find by experiment we need, as we shall instruct you further on, may be it will be bone meal and may be kainit.

There is much difference in plaster, in quality and price as well. The kinds in use here are largely Nova Scotia and Onondaga. The price of the first will perhaps average $8.00 per ton to the consumer and of the last perhaps $5.50 or $6.00.

We select from various analyses one of each from those of Prof. Goessman which may represent about the average of each kind.

NOVA SCOTIA PLASTER (GYPSUM).

	Pounds per hundred.
Calcium oxide	32.17
Magnesium oxide	1.40
Sulphuric acid	44.00
Insoluble matter	.70

The sample contains 94.8 per cent. of gypsum, and is a fair article.

ONONDAGA PLASTER (GYPSUM).

	Pounds per hundred.
Calcium oxide	29.15
Magnesium oxide	3.89
Sulphuric acid	31.82
Insoluble matter	9.25

Its cost corresponds well with its percentage of gypsum,—67 to 69 per cent.

Crude kieserite can often be used also, if obtained at fair prices. The analysis of a usual sample we give herewith.

CRUDE KIESERITE.

Moisture at 100° C	28.12
Magnesium oxide	17.45
Calcium oxide	3.13
Sulphuric acid	36.87
Insoluble matter	3.62

The sample contained 48.6 per cent. of sulphate of magnesia, from 7 to 8 per cent. of gypsum , and 2.23 per cent. of chloride of magnesium ; it is consequently of fair quality. The kieserite, as an absorber of ammonia, may profitably be used in many instances as a substitute for gypsum.

COMMON SALT (CHLORIDE OF SODIUM).

One important office of the salt is to make soluble, and consequently useful to the plant, the materials already locked up, as it were, in the soil. Supposing you have been putting on barn-yard manure and other fertilizers. Some of the nutritive material, as for instance potash and phosphoric acid, may perhaps have been taken up by the soil, and remain there in a difficultly soluble condition. Furthermore, there are in the soil some of these ingredients that were in the original rock of which the soil is made up, and are still so to say locked up, or in other words still remain in an insoluble form therein. One effect of salt, as is the case oftentimes with gypsum and lime, is to set loose that potash and phosphoric acid. You must expect, therefore, in putting on salt, that its chief use will be, not as direct nutriment to the plant, but rather as a means of setting other materials loose; and salt is very useful on this account, because it is not readily absorbed in the upper layers, of the soil, but often leaches through into the lower layers, and it will have the effect of setting those materials free all the way down. The German farmers say, however, that you must be careful in the use of salt. If you put on too much, it injures the vegetation. Further, it will not do to put it on loose soil. A very loose, sandy soil, is not ordinarily, benefited by the application of salt. Again, it is best applied to soils which contain considerable humus. And salt on a soil of that character will help the crop.

It is also almost a necessity on asparagus beds and may be put on until all weeds are killed, without danger to the asparagus. Muriate of potash is however said to be better than common salt, as the potash is plant food while the soda is not.

From what we have said it will be seen that salt must be beneficial to almost all soils and should be more generally used. There is an impure article sold under the name of agricultural salt that is almost if not quite as good as any and may be had at low price. We believe nearly every farmer will derive great benefit from composting this with his manure.

ANALYSIS OF AGRICULTURAL, OR REFUSE SALT. (CHLORIDE OF SODIUM).

Moisture at 100° C	1.70
Calcium oxide	1.21
Magnesium oxide	.41
Sulphuric acid	1.57
Sodium chloride	95.38

ASHES.

All farmers should look well to the saving of the ashes from their stoves, arches and sugar places, for the potash and phosphoric acid are usually of great value to them, and if not they have a constantly increasing market value and may be exchanged for what will be beneficial. Ashes can be composted with manure if carefully done, yet many prefer to use them alone. It is not desirable to mix ashes with hen manure or acid phosphates, unless immediately before using, and perhaps it is better not to mix at all, but if stable manures are composted with muck they can be well mixed therein. If ashes are neededand a sufficient amount cannot be obtained, muriate of potash or kainit may be substituted to advantage, and either can be better used in the home manufacture of concentrated fertilizers than ashes. We give analyses of such as we think most beneficial, in all cases intending to give that of the usual quality. In some instances we give more than one, that you may see how different samples analyze.

Analysis of four samples wood ashes, of fair quality. Nos. III and IV are better than an average. Nos. I and II are moist, and perhaps partially leached by exposure to weather.

	I.	II.	III.	IV.
	Pounds per hundred.			
Moisture at 100° C	17.00	18.15	4.90	2.48
Potassium oxide	4.28	4.80	7.42	6.53
Calcium oxide	31.31	30.69	42.10	42.98
Magnesium oxide	2.36	3.71	3.55	3.66
Phosphoric acid	3.34	3.26	2.00	1.44
Insoluble matter	15.50	17.35	7.12	4.87

Analysis of three samples Canada, wood ashes, of good quality.

	LBS. PER HUNDRED.		
	I.	II.	III.
Moisture at 100° C	16.55	11.95	6.75
Calcium oxide	34.42	39.60	34.71
Magnesium oxide	2.52	2.28	2.45
Potassium oxide	5.36	6.46	6.30
Phosphoric acid	2.06	1.77	2.21
Insoluble matter	24.10	10.12	16.10

Analysis of four samples wood ashes, the two first leached as farmers usually do it for soap-making, or as they may be leached by exposure to weather.

	LBS. PER HUNDRED.			
	I.	II.	III.	IV.
Moisture at 100° C	8.80	14.40	12.93	15.73
Potassium oxide	2.18	2.25	5.50	5.93
Calcium oxide	45.90	34.33	33.99	35.45
Magnesium oxide	3.63	3.13	4.22	3.41
Phosphoric acid	2.22	1.79	2.05	1.60
Insoluble matter	8.86	14.40	10.42	10.29

Analysis of three samples muriate of potash, collected from different lots.

	LBS. PER HUNDRED.		
	I.	II.	III.
Moisture at 100° C	1.00	0.05	0.90
Potassium oxide	51.94	49.60	50.80
Valuation per 2,000 lbs	$44.15	$42.16	$43.18

This form of potash compounds has proved to be one of the most reliable potash resources for field and garden.

KAINIT.

Moisture at 100° C	2.15
Calcium oxide	.82
Magnesium oxide	11.30
Potassium oxide	16.48
Sulphuric acid	21.91
Valuation per 2,000 lbs	$14.08

This is a fair sample of its kind. Potash, in form of kainit, has been applied with much success for forage crops. It deserves a careful trial upon pastures and meadows, in connection with bone fertilizers.

KRUGIT.

	Per cent.
Moisture at 100° C	4.82
Sodium oxide	5.57
Potassium oxide	8.42
Calcium oxide	12.45
Magnesium oxide	8.79
Sulphuric acid	31.94
Chlorine	6.63
Insoluble matter (in acids)	14.96

This saline belongs to the products of the "German Potash Industry" at Strassfurt. It contains from 15 to 16 per cent. of sulphate of potassa, besides sulphate of lime (gypsum), sulphate of magnesia (epsom salt), and chloride of sodium (common salt), etc. A careful trial of the article upon hill pastures, as a top-dressing, in connection with fine ground bones, deserves attention. It sold at $14 per ton of 2,000 pounds, on board of cars in Boston.

COMPOSTING BY HOGS.

Farmers sometimes neglect composting because they have to hire help at high prices to do the work. To farmers thus situated we would urge upon them the acceptance of labor from the hog. They are great workers if the material they are asked to work over contains now and then a nut or a little corn. Many times they will labor for hours with no apparent reason only the fun of the thing. If you have knolls of brakes in your pasture or fields, plow them off; take them to the hog-pen, with leaves or any other refuse, and the hogs will make all into valuable compost. Cart muck, or if you do not have it, the weeds from your fields and road wash, refuse straw, or any coarse material gathered where you dig out roots of noxious plants. They will make all into a valuable fertilizer. Be sure to keep in enough, all the time, to keep your pens dry and salt also mixed in, so if trodden down the mass will not heat and injure your hogs. The amount of gain by attention to this matter will more than pay for keeping the hogs, and what they are worth will be found a net profit; or you may put it another way, and say that hogs for their pork will barely pay for their feed, their labor for you is clear gain. It seems to us that every farmer should utilize their labor in this way.

OTHER FERTILIZING MATERIALS.

We give an analysis as collected from reliable sources of average articles used, or that should be used by farmers in their experiments and if found valuable as fertilizers on their land may pay them very large profits on investments. It is our belief that no fertilizers should be purchased until all the manurial products of our farms are fully utilized and then purchased to use in connection with such material in composting or otherwise.

LIME KILN ASHES.

	Per cent.
Moisture at 100° C	30.70
Calcium oxide	37.55
Magnesium oxide	3.68
Potassium oxide	1.70
Phosphoric acid	1.27
Carbonic acid	17.83
Insoluble matter	3.30

Sold for 15 to 22 cents per bushel.

The material is a fair sample of its kind.

REFUSE LIME.

	Per cent.
Moisture at 100° C	33.54
Phosphoric acid	1.62
Magnesium oxide	8.30
Calcium oxide	40.57
Insoluble matter	.40

This is the same value as common air-slaked lime.

ANALYSIS OF MATERIALS USED IN SUPERPHOSPHATES.

SOURCES OF NITROGEN. NITRATE OF SODA.

	Per cent.
Moisture at 100° C	1.25
Nitrogen	15.57
Insoluble matter	0.45

Valuation per two thousand pounds, $62.28.

DRY GROUND FISH.

Moisture at 100° C	10.38
Total phosphoric acid	6.00
Soluble phosphoric acid	2.82
Reverted phosphoric acid	
Insoluble phosphoric acid	3.18
Nitrogen	6.13

Valuation per two thousand pounds, $36.53.

FISH WASTE.

	Per cent.
Moisture at 100° C	41.92
Total phosphoric acid	5.20
Soluble phosphoric acid	.83
Reverted phosphoric acid	2.02
Insoluble phosphoric acid	2.35
Nitrogen	7.60
Insoluble matter	.28

Valuation per two thousand pounds, $34.37.

FISH POMACE.

	Per cent.
Moisture at 100° C	44.41
Total phosphoric acid	5.85
Soluble phosphoric acid	1.57
Reverted phosphoric acid	0.62
Insoluble phosphoric acid	3.62
Nitrogen	5.27

Valuation per two thousand pounds, $33.02.

FISH WASTE.

	Per cent.
Moisture at 100° C	71.11
Nitrogen	2.21
Phosphoric acid	0.60
Fat	0.45

Valuation per two thousand pounds, $4.58.

The article consisted of coarse pieces of fish, and its valuation is based for that reason on the rates of cost adopted for coarse fish-scraps: Nine cents per pound for nitrogen and five cents per pound for phosphoric acid.

GROUND HORN.

Moisture at 100° C	10.00
Organic and volatile matter	95.00
Ash	5.00
Phosphoric acid	1.36
Nitrogen in organic matter	13.53

Valuation per two thousand pounds.

270.6 lbs. nitrogen at 10 cents	$27.06
27.2 lbs. phosphoric acid at 4½ cents	1.22
	$28.28

The inferior mechanical condition of the article advises the low valuation of the nitrogen present.

AMMONITE.

Guaranteed composition: Ammonia, 15 to 16 per cent. (equivalent to nitrogen, 12.4 to 13.2 per cent.); phosphoric acid, 4 to 6 per cent.

	Per cent.
Moisture at 100° C	5.88
Total phosphoric acid	3.43
Nitrogen (=ammonia, 13.76 per cent)	11.33
Insoluble matter	1.38

Valuation per two thousand pounds, $45.90.

The article consists, evidently, of fine ground animal matter, freed from fat. Its general physical character is apparently favorable to a speedy disintegration. The material deserves attention as a source of nitrogen for plant growth.

SOURCES OF PHOSPHORIC ACID.

FINE GROUND BLEACHED OR WEATHERED BONES.

	Lbs. per hundred.
Moisture at 100° C	3.65
Total phosphoric acid	26.37
Reverted phosphoric acid	16.78
Insoluble phosphoric acid	9.59
Nitrogen	2.90
Insoluble matter	2.65

Valuation per two thousand pounds, $44.96.

FINE GROUND RAW BONE.

	Per cent.
Moisture at 100° C	4.63
Total phosphoric acid	22.41
Nitrogen	3.69

Valuation per two thousand pounds, $43.86.

MEDIUM GROUND BONE.

	Per cent
Moisture at 100° C	4.78
Total phosphoric acid	29.83
Reverted phosphoric acid	9.22
Insoluble phosphoric acid	20.61
Nitrogen	2.03
Insoluble matter	0.30

Valuation per two thousand pounds, $34.79.

BONEBLACK WASTE.

	Per cent.
Moisture at 100° C	10.65
Total phosphoric acid	29.64
Insoluble matter	2.80

Valuation per two thousand pounds, $23.71.

This article is best used in the form of a superphosphate, commonly called dissolved boneblack.

GROUND SOUTH CAROLINA PHOSPHATE ROCK.

	Per cent.
Moisture at 100° C	1.90
Total phosphoric acid	27.13
Insoluble matter	11.90

Valuation per two thousand pounds, $12 21.

TWO SAMPLES BONEBLACK.

	Lbs. per hundred.	
	I.	II.
Moisture at 100° C	1.55	2.50
Phosphoric acid	30.54	23.47
Ash	80.85	58.45
Calcium	45.73	
Valuation per 2,000 lbs.	$27.49	$21.12

Boneblack refuse in a fine ground condition may be profitably used for composting.

THREE SAMPLES DISSOLVED BONEBLACK.

I.

	Per cent.
Moisture at 100° C	20.78
Total phosphoric acid	15.66
Soluble phosphoric acid	12.76
Insoluble phosphoric acid	2.90

Valuation per two thousand pounds, $31.55.

II.

	Per cent.
Moisture at 100° C	10.05
Total phosphoric acid	17.56
Soluble phosphoric acid	16.84
Reverted phosphoric acid	.44
Insoluble phosphoric acid	.28
Insoluble matter	1.08

Valuation per two thousand pounds, $31.24.

III.

	Per cent.
Moisture at 100° C	11.73
Total phosphoric acid	17.34
Soluble phosphoric acid	16.64
Reverted phosphoric acid	.44
Insoluble phosphoric acid	.26
Insoluble matter	11.98

Valuation per two thousand pounds, $30.86.

PURE DISSOLVED RAW BONES.

	Per cent.
Moisture at 100° C	10.23
Total phosphoric acid	16.03
Soluble phosphoric acid	7.76
Reverted phosphoric acid	3.83
Insoluble phosphoric acid	4.44
Nitrogen	2.64

Valuation per two thousand pounds, $40.67.

I also give the manurial value of cotton seed meal, wheat bran and apple pomace.

COTTON SEED MEAL (COARSE).

	Per cent.
Moisture at 100° C	6.80
Organic and volatile matter	94.23
Ash constituents	5.77
Phosphoric acid	1.45
Potassium oxide	.89
Calcium oxide	.39
Magnesium oxide	99
Nitrogen	6.10
Insoluble matter	.60

Valuation per two thousand pounds, $24.46.

WHEAT BRAN, SAMPLES 1 AND 2.

	I.	II.
	Per cent.	
Moisture at 100° C	11.45	9.40
Phosphoric acid	3.05	3.12
Magnesium oxide	0.90	0.91
Sodium oxide	0.09	0.16
Potassium oxide	1.49	1.42
Nitrogen	2.82	3.08
Insoluble matter	0.11	0.15

Valuation per two thousand pounds, $13.91 and $14.80.

APPLE POMACES.

I. Rhode Island Greening. II. Baldwin Apple.

	I.	II.
	Lbs. per hundred.	
Moisture at 100° C	78.220	82.780
Dry matter	21.780	17.220
Nitrogen	1.110	1.240
Crude ash	1.090	1.780
Potassium oxide	0.548	0.875
Sodium oxide	0.151	0.121
Calcium oxide	0.194	0.189
Magnesium oxide	0.128	0.164
Ferric oxide	0.039	0.049
Phosphoric acid	0.081	0.107
Insoluble matter	0.041	0.050

Valuation per two thousand pounds, $4.34 and $5.09.

Apple pomace is usually a waste product, yet could it not be used to advantage as a fertilizer? We see no reason why it should not be. It should be the chief aim of all to save and utilize waste products.

We have now considered some of the available fertilizers of the farm and also of commerce, as well as something of composting and thus rendering available by division, what as a compact body we could not so well utilize. Now let us consider the composts, or

HOME-MADE FERTILIZERS.

The constant demand for recipes for composts, and formulas for home-made fertilizers, is such that we publish a few that have been tried with success.

There are countless formulas offered to our farmers. We have no intention of supplanting or deciding between them. Whatever our views as a people, whatever the views that agricultural chemists hold as to the benefit of chemical manures, no one will deny, that it is of the utmost importance in the economy of the farm, to utilize all fertilizing material which the farm can supply. To this end these directions have been prepared. By following them we can save money, and "a penny saved is a penny earned."

In a state where ninety per cent. of the population burn wood, no one will deny that the ashes should be utilized.

We need year by year to increase our home supply of fertilizers, in that laudable effort, let us use every means to prepare our own manures and save our money.

FORMULA NO. 1.

Raw ground bone contains both phosphoric acid and combined nitrogen, and when mixed with ashes the compound is a complete fertilizer. But raw ground bone contains a good deal of grease, which keeps out the water and prevents its decomposition in the soil. To cure this defect we mix the ground bone with the ashes (two or three barrels of ashes to one of bone) and pack the mixture firmly into barrels, making holes nearly to the bottom with a broomstick or hoe handle, and pouring in enough water to soak the mixture without making it leach. This dissolves all the grease, and also "cuts" or softens the nitrogenous animal matter of the bone, so that it is all ready for the plants to use. All can see that this is more easily and safely made, and a more complete fertilizer than one made with bone and acid. If three barrels of ashes are used to one of bone, it is well to keep one until the rest of the ashes mixed with the bone have taken effect; (one, two or three weeks, according as you have time to wait, but the longer the better.) Before applying it to land, turn out the mixture in the barrels, and with a shovel mix the reserved dry ashes with it. This makes it better to handle, and easier to spread. Use this mixture just as you would a purchased fertilizer, but in double the quantity.

FORMULA NO. 2.

Two thousand pounds fine ground South Carolina phosphate	$15.00
Ten bushels unleached hardwood ashes	2.50
One hundred pounds sulphate of ammonia	6.00
Total	$23.50

Mix thoroughly, by shoveling over six or seven times on the barn floor. It should be so mixed, that when finished, every spoonful will be like every other spoonful. Better go over it too many times than too few.

FORMULA NO. 3.

Two thousand pounds fine ground South Carolina phosphate	$15.00
Ten bushels unleached hardwood ashes	2.50
Three hundred and fifty pounds cotton-seed meal	5.25
Total	$22.75

Fertilizers made upon the above formulas will be found as effective in every respect, used cost for cost, on all farm crops, as good stable manure, and quite as lasting. They should be sown broadcast.

FORMULA NO. 4.

First dissolved bone is manufactured as follows:

Bone, fine ground	100	lbs.
Sulphuric acid	75	"
Water	40	"
Bone for dryer enough to make up	225	"

Of this dissolved bone is taken	800	"
Raw bone	100	"
Salt	100	"
Humus, or muck dried	800	"
Ashes	100	"
Muriate of potash	100	"
Total	2,000	lbs.

Carefully and perfectly mix.

This was used two years by one of our manufacturers of superphosphates. His goods analyzed high and had a ready sale. Allow us to add that the muck used was a very superior article, the swamp having been used as a grave yard for dead animals, for many years previous to its use as a muck bed, hence there was an advantage there over the use of ordinary muck. When bone meal is dissolved in acid it must first be wet until the mixture is quite soft with water, then the acid added slowly. It will foam and boil, and as soon as that ceases, more bone meal must be added, enough to make the mixture in good condition to handle. This compost according to Prof. Sabine analyzed as follows:

	Per cent	No. of lbs. in ton	Worth.
Nitrogen	1.7	34	$5.78
Soluble phosphoric acid	2.2	44	3.52
Reverted phosphoric acid	8.1	162	12.15
Insoluble phosphoric acid	1.4	28	.84
Potash	4.0	80	3.60
Estimated value			$25.89

FORMULA NO. 5.

Stable manure	800 lbs.
Cotton seed meal	750 "
Dissolved bone black	450 "

To prepare this spread under your compost shed the manure two inches deep, then dissolved bone same depth, to be followed by the cotton seed meal four inches thick. Wet down with urine from the stables, or chamber lye and soap-suds from the house. Then repeat the layers and wet as before. After all has been put in, cover your heap with a layer of plaster; dry muck will do. Fermentation will be complete in five or six weeks. Thoroughly mix and use two or three hundred pounds to the acre. This formula will do excellently for wheat, 300 to 400 pounds per acre. But when used on this crop, we prefer 50 pounds sulphate of potash dissolved in water and applied as directed in the wetting down. After a backward season 100 pounds of nitrate of soda per acre, broadcast, in the spring, will help the crop very greatly.

FORMULA NO. 6.

Dry muck, peat or yard scrapings	600 lbs
Cotton seed	600 "
Acid phosphate	600 "
Muriate of potash	100 "
Sulphate of ammonia	100 "
	2,000 lbs.

This formula should be composted in the same manner as No. 5. The muriate of potash and sulphate of ammonia being dissolved in water and used to wet the heap, may be applied in the same proportions. For wheat, and rye or oats (use 200 pounds per acre) it may be harrowed in with the grain.

FORMULA NO. 7.

Stable manure	500 lbs.
Unburnt marl	500 “
Salt	200 “
Dissolved bones	500 “
Sulphate of Potash	150 “
Sulphate of ammonia	150 “
	2,000 lbs

This formula may be prepared by composting in layers, as in No. 5, or mix the marl and salt together thoroughly, and apply the mixture as a covering to the compost of cotton seed meal, stable manure and dissolved bone, then sprinkle with the solution of sulphate of ammonia, and turn the whole over once in two weeks till fermented. The same rules of application given previously, to be used.

FORMULA NO. 8.

Stable manure, mould, etc	1,000 lbs.
Sulphate of potash	300 “
“ ammonia	100 “
“ magnesia	100 “
Dissolved bone	400 “
Land plaster	100 “
	2,000 lbs.

Where chemicals are not to be obtained, good stable manure and a high grade commercial fertilizer in place of the sulphates and dissolved bone, may be used, with a plentiful addition of hard-wood ashes or kainit.

In regard to the amount to be used per acre; no general rule can be given—it should vary with the condition of the soil, from 200 to 500 pounds per acre.

FORMULA NO. 9.

Bone meal, fine	200 lbs.
Sulphuric acid	50 “
Kainit	200 “
Muck, or road dirt	400 “

First divide the bone meal by sifting. Take the coarsest half and add four or five pails of water, until it mixes up quite soft· then slowly add the acid stirring constantly. When through foam, ing add the other half of the bone meal and stir in, then add the fourteen hundred pounds dry muck or road dust, mix thoroughly; while mixing add the kainit We have added the kainit by dissolving and sprinkling on the muck beforehand, and like that way well; though it may be added afterward by sprinkling from a saturated solution. The wet will do no damage.

Use two hundred pounds to the acre, same as any commercial manure.

Formulas for such preparations are endless in variety and worth, but any of them should be used only in connection with stable manures, as the profits in that way are greater than from their use on worn-out land without any manure. If the land is in good heart they are ample for a maximum crop. Let us now consider the

TIME OF APPLICATION OF THE FERTILIZERS.

It is usual to apply in spring-time, and we supposed that the best, until by a series of experiments, extending over sixteen years, we became convinced that such was not the fact.

After we became convinced of this truth, we sought for the reason. We believe that the plant food from our manurial elements, whatever they may be, needs, first to be dissolved in water and thus distributed in the soil, that it may be available to the rootlets of the growing plant. After spring applications, there are many seasons that we do not get rain enough to do this work. If we apply in fall or winter, the melting snow and spring rains, prepare the ground by distributing the soluble plant food, for the incoming plant, which can then get an advantage from such food, without abundant supply of water.

Those that do not favor such application, we would ask to try and see, if it was not better so to do. It is not probable that on a light soil it would be best and yet the danger from washing has been greatly overrated. It is so small that on our farm we have not yet found it, still we believe on some soil it must be worth looking after. Carry on a series of those experiments for yourselves, and the result will tell.

MANNER OF APPLICATION.

As we apply fertilizers in winter, it is evident there is but one way to use them, and that is broadcast, yet we believe at any season this is best There are, however, a multitude of machines in use for dropping in hills and drills that are better than broadcast machines. Such being the fact it wlll be a long time, before all will adopt the broadcast method, even if they believe it best. We have used in our experiments a little hand dropper of fertilizers, known as Randolph's and made at Liberty Corner, Somerset county, N. J., by P. F. Randolph, himself.

It is a wonder of perfection. Can be set to drop any given quantity per acre, and where horse machines are not used it is an advance. It does not leave it in a bunch, but as it should, properly scattered. We are sorry it is not on sale in Vermont, as we understand the whole outfit costs but four dollars.

We would advise all hand droppers, to procure one, and after they become convinced of the great improvement through this machine, try broadcasting, which we believe the next advance step.

MANURE AT THE SURFACE.

It was a long and hard lesson for us to learn, that manure at the surface was worth many times more than when buried with the plow, but numerous experiments gained the day, as it will with all who till anything but sandy soil? and even there we find its advocates.

If there are any who till upland loam or clay soil who are not already converted, we trust they will at once institute experiments to convince themselves which is the correct way. The only way we can be certain of a fact, is to try and disprove it. A truth stands all tests, a falsehood soon vanishes, and leaves a fact in its place. Let all try for themselves.

MANURE REQUIRED.

Plot experiment tells us this. Many times a costly application is made to a large field without any return, and many times a crop is sown, cultivated, and harvested, which does not pay the expense of its production, when a few dollars worth of some fertilizer would have made it remunerative. One such failure often involves more present loss than the cost of conducting a series of these experiments, while the indications to be gathered from systematic investigation of this sort, in respect to the future management of the land, would often make the difference between a losing and a paying husbandry.

This method of employing the crops to reveal the resources of the soil and the action of manures, is capable of manifold application. By it the relative value of different forms of fertilizing elements, the most economical amount to use, the depth or mode of applying, and the best fertilizer for each crop, or the best point in a rotation at which to employ a given manure, can be studied. The only barrier to the use of such guiding ideas as we have thus briefly noticed, is want of faith in their practical value and efficacy. This want of faith will always result from lack of knowledge. To make these ideas bear full fruit we must apprehend them in their details, and in all their bearings. This knowledge can only come from study, from a survey of the entire field of agricultural science, when we educate ourselves to the mastery of these ideas, zealously, as we now seek information with respect to new implements, new seeds, and new modes of culture, we shall handle them with ease and employ them with profit.

METHOD OF EXPERIMENT.

This method consists in observing the effects of each element of plant food, or of each available fertilizer, applied by itself to a plot of suitably prepared ground, upon a crop or a succession of crops. For many ordinary purposes plots of a small area—a square rod—are sufficient, if the soil is uniform in quality and depth over a considerable surface, as shown by the uniform stand of the crops in former years. It is better, however, to have a long and narrow plot of ten or fifteen square rods area, because thus the inequalities of the soil are less likely to disturb the results. The ground being prepared for a crop, a number of measured plots or strips are laid off, and different fertilizing matters are applied to them in appropriate quantities. On one, for example, use gypsum, on another fresh-slaked lime, on another superphosphate made from bone ash or bone-black and oil of vitriol, but without nitrogen, on another pulverized "blood and meat scrap," rich in nitrogen, but nearly free from phosphates;

on another sulphate of ammonia, on a sixth muriate of potash, on a seventh a nitrogenous superphosphate, or fish guano, on an eighth stable manure, etc. Two or three plots with no manure should intervene to furnish a basis for comparison. The experiments should extend over a series of three or four years, the same plots being each year treated with the same kinds and quantities of fertilizers, but cultivated with different crops. Such trials require, indeed, some outlay of labor, and some nicety in execution. The plots must be measured accurately, and their boundaries must be defined by suitable stakes. They should be separated from each other by a vacant space of two or three feet, and great care must be used to distribute each fertilizer over the plot to which it is assigned, and to confine it to those limits. Finally, to complete the trials the crops should be separately harvested and weighed. The trouble and expense of such experiments is trifling compared with the information which they, and they alone, can give the farmer regarding the needs of the soil and crop, and the effects of fertilizers.

The method of experiment not only applies as to kind of fertilizer, but amount, and the farmer must pursue this course if he would reap rich success.

You cannot get round it any better, than you can scale the battlements to heaven. There is a straight and narrow way and all who are crowned with success must walk therein.

RESULTS OF EXPERIMENTS.

After what we have said we give you some of the results from our book of experiments, running through several years, the profits derived from the use of commercial fertilizers, so called, as ascertained by plot experiment. In all instances the soil was in good condition and without the fertilizers, bore a good crop.

The fertilizers have been of various prices, but we select only such as had a uniform weight of 200 pounds to the acre applied, and only such as gave a profit, all cost of application, purchase money, and even interest on the same, has been deducted; showing actual net gains, on well tilled lands, from their additional use.

They were all used broadcast and all applied in the spring, yet in some instances some days before the seeds were put in.

They show that while all first class fertilizers are good, that any man can from them select those that are best for his case. In these experiments there can be no guess, all must be weighed and the utmost care given to the book keeping, that you may know the results, without any doubt resting with them.

CROP, POTATOES.

Year.	Name of Superphosphate.	Net profit per acre from use.
1872	Fale's Concentrated Fertilizer	$2.85
	Bradley's Patent Superphosphate	26.62
	Paddock & Denn's Superphosphate	7.82
	Grafton Mineral Fertilizer	.62
	Stevens' Mineral Fertilizer	.90
	Ammoniated Green Mountain Soluble Phosphate	27.20
	Brighton Bone Phosphate	25.26
1878	Cumberland Superphosphate	29.80
	Stockbridge Manure	33.20
	Land Plaster	14.85
	Fine Bone Meal	31.92
1883	Buffalo Bone Superphosphate	65.15
	Slack's Dissolved Bone	64.09
	Bowker's Stockbridge Manure	34.25
	Quinnipiac Superphosphate	55.80
	Cumberland Superphosphate	39.70
	Common Sense Fertilizer, No. 2	6.65
	“ “ “ D	9.90
	Land Plaster	14.90
	Bone Meal, fine ground	61.39
1885	Americus	43.85
	Plaster	13.10
	Qunnipiac Superphosphate	42.18
	South Carolina Phosphate Rock (Fine)	19.76
	Bone Meal, Fine	32.19
	Kainit	21.11
	Salt	7.64
	Lister's Dissolved Bone	30.92

AMOUNT TO BE USED.

This is another point on which we all need experiment, as the amount is even more important, than the kind, of superphosphates.

We give in the following table the result of four series of experiments, for amount; showing very fully the neccessity for such careful investigation.

No of lbs. per acre.	Name of Superphosphates.	Profit.	Loss.
50	Buffalo Bone Superphosphate	$19.14	$
100		28.38	
150		44.48	
200		65.15	
300		48.90	
400		9.40	
500			2.18
50	Slack's Dissolved Bone	20.02	
100		50.68	
200		64.09	
300		32.18	
400		9.21	
500			7.31
100	Quinnipiac Superphosphate	43.20	
200		55.80	
300		38.16	
400		4.36	
500			4.92
800	Cumberland Superphosphate, (Total loss)		126.00
200	“ “	39.70	

Prof. W. W. Cook in discoursing of the results of the experiments with nitrogen said he believed that farmers did not need to purchase much or any nitrogen or ammonia, but that all neccessary could be secured from the air and from stable fertilizers, if all both liquid and solid were saved. He said such liquids should be saved by absorbents, and that all should be taken to the fields and spread before the Spring rains or at any convenient time in the Winter season. He then gave the result of four years experiments with nitrogen, at the rate of twenty-four pounds to the acre and also at the rate of fourty-eight and seventy-two pounds, showing a loss in all the experiments of about $1.00 on twenty-four pounds, about $7.00 on forty-eight pounds, and $15 on seventy two pounds, per acre. He then showed how injurious it was in combination, by an experiment, where

Phosphoric Acid gave a net profit of	$16.50
Potash	7.84
The two combined with Nitrogen, only	4.64

He than spoke of commercial fertilizers, as sold, and gave results of eleven experiments, where the net profits per acre in one instance on potatoes was $84.60 and in another only $1.40, and yet the difference in price of the fertilizers was very slight,—showing how it was neccessary to try experiments and see which was best for each individual to purchase. He then advocated the use of home made fertilizers, and said a judicious saving of all offal about house and barn was a necessity if the largest gain was desired. He advocated in all cases the keeping up of the soil, so that maximum crops be raised, and to do so a little plant food must be given each year. He advised the use of salt and of lime or plaster, if beneficial, but at the same time other fertilizers should be added; a reliance upon these wholly would decrease fertility, yet their use was often beneficial and anything that was so should be used. In all instances the amount of anything put upon the soil should be first judicously ascertained by plot experiment.

There was no other way ; the Yankee guess was here at fault.

VALUE OF COMMERCIAL FERTILIZERS.

Commercial fertilizers, or concentrated manures, are manufactured for two reasons: One to supply demand, and the other to make money. When first sold in Vermont in 1870, I find the analysis of Bradley's Patent Superphosphate, as analyzed by Prof. Collier, to be as follows:

	Per ct.	Lbs. per ton.	Value
Nitrogen	1.78	35.60	$6.05
Soluble phosphoric acid	1.49	29.80	2.38
Reverted phosphoric acid	4.50	90.00	6.75
Insoluble phosphoric acid	6.89	137.80	4.13
			$19.31

The valuation at the present standard would be $19.31, while you see the same goods sold in Vermont today show about double that value. Others sold at that time were worthless, as the mineral fertilizers. Analyses by Prof. Collier given.

GRAFTON MINERAL FERTILIZER.

	Per cent.
Silica	39.87
Carbonic acid	26.97
Sulphur	.25
Lime	16.95
Magnesia	9.52
Oxide of iron	6.44
Manganese, zinc, alumina, etc	traces.
	100.00

VALUATION.

To the several constituents present in the above, agriculturists have never yet assigned any value, and of course there exists therefore no basis upon which to fix a price. Very careful experiments are needed to show that as a fertilizer it is worth a dollar a ton.

STEVENS' MINERAL FERTILIZER.

	Per cent.
Silica	97.61
Carbonic acid	.94
Lime	.03
Magnesia	.04
Iron oxide	1.38
	100.00

VALUATION.

The fertilizing value of the above is of the same character as that of the Grafton Mineral Fertilizer. Whatever may be its effect upon the plant, it seems in the highest degree improbable that either it, or the Grafton Mineral Fertilizer, are of any value as affording direct food to the growing plant.

Bradley's goods at that time were doubtless as good as any on the market, and we trust the mineral fertilizers the worst; but others were but little behind. Within a few years the improvement has been great, and we trust it will go on until we are as well served as in England and Germany.

The above trade-values are the figures at which in March the respective ingredients could be bought at retail for cash, in our large markets, in the *raw materials*, which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about twenty per cent. in case of goods for which we have wholesome quotations. The valuations obtained by use of the above figures will be found to agree fairly with the *reasonable retail price* at the large markets of standard raw materials such as :—

- Sulphate of Ammonia,
- Nitrate of Soda,
- Muriate of Potash,
- Sulphate of Potash,
- Dried Blood,
- Plain Superphosphate,
- Azotin,
- Dry Ground Fish,
- Cotton seed,
- Castor Pomace,
- Bone,
- Ground So. Car. Rock.

For wholesale price deduct about seventeen per cent.

PRICES OF WHAT FARMRES NEED PURCHASE.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	CENTS PER POUND.					
	1881.	1882.	1883.	1884.	1885.	1886.
Nitrogen in ammonia salts	22½	29	26	22	18	18½
Nitrogen in nitrates	26	26	20	18	18	18½
Nitrogen in dried and fine ground fish	20	24	23	20	18	17
Organic nitrogen in guano, and fine ground blood and meat	20	24	23	18	18	17
Organic nitrogen in cotton seed, linseed meal, and in castor pomace	16	18	18	18	18	17
Organic nitrogen in fine ground bone	15	17	17	18	18	17
Organic nitrogen in medium fine bone	14	15	15	16	16	15
Organic nitrogen in medium bone	13	14	14	14	14	13
Organic nitrogen in coarse medium bone	12	13	13	12	12	11
Organic nitrogen in coarse bone, horn shavings, hair, and fish scraps	11	11	11	10	10	9
Phosphoric acid, soluble in water	12½	12½	11	10	9	8
Phosphoric acid, soluble in ammonia citrate*	9	9	8	9	8	7½
Phosphoric acid, insoluble in dry, fine ground fish, and in fine bone	6	6	6	6	6	7
Phosphoric acid, insoluble in fine medium bone	5½	5½	5½	5½	5½	6
Phosphoric acid, insoluble in medium bone	5	5	5	5	5	5
Phosphoric acid, insoluble in coarse medium bone	4½	4½	4½	4½	4½	4
Phosphoric acid, insoluble in coarse bone	4	4	4	4	4	3
Phosphoric acid, insoluble in fine ground rock phosphate	3½	3	2¾	2¼	2	2
Potash as high grade sulphate	7½	7	7	7¼	7¼	5½
Potash as kainit	5½	5	4¼	4¼	4½	4¼
Potash as muriate	4½	5	4¼	4¼	4½	4¼

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*Dissolved from two grams of phosphate, unground, by 100 c. c. neutral solution of ammonia citrate, sp. gr. 1.09 in 30 minutes at 40 deg. C., with agitation once in five minutes; commonly called "reverted" or backgone phosphoric acid.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADES.

The organic nitrogen in these classes of goods is reckoned at the highest figure laid down in the trade values of fertilizing ingredients in raw materials, namely, seventeen cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, blood, animal matter, or other equally good forms and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble phosphoric acid is reckoned at three cents, it being assumed, unless found otherwise, that it is from bone or similar source and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but two cents per pound. Potash is rated at 4¼ cents, if sufficient cholorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned as sulphate at 5½ cents.

In most cases the valuation of the ingredients in superphosphates and specials falls below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally, profits.

In 1885 the average selling price of ammoniated superphosphates and guanos was $37.60, the average valuation was $30.47, and the difference $7.23—an advance of 23.4 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of specials the average cost was $44.80, the average valuation $38.70, and the difference $6.10 or less than 16.0 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

The mechanical condition of any fertilizing material, simple or compound, derserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant-food throughout the soil. The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance.

Two samples of fish fertilizer, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Consumers of commercial manurial substances do well to buy whenever practicable, on a guaranty of composition with reference to their *essential constituents;* and see to it, that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article, corresponding in its composition with the *lowest* stated quantity, of each specified essential constituent.

ANALYSIS OF FERTILIZERS.

The following analyses by Professor W. W. Cooke, state chemist, have been received. The samples were carefully drawn from different lots in variaus parts of the state, and the analyses show generally a considerable improvement in the different grades previously sold. This, and the decline in price are both advantageous to the farmer.

The methods used in analyses were such as are usual, and were as follows:

Phosphoric Acid.—The phosphoric acid was determined by the ammonium citrate method, as recommended by the convention of agricultural chemists at Atlanta, Georgia, and precipitated with magnesia solution.

Potash.—The potash was determined, as usual, by means of platinum bichloride.

Nitrogen.—The total nitrogen was determined by the absolute method with copper oxide.

EXPLANATION OF TERMS.

Nitrogen is, commercially, the most costly of any fertilizing element. Organic nitrogen is the nitrogen of animal matter, as well as vegetable, and is found in the decomposing material of either. It is immediately available from blood, meat, stable manures and decomposed vegetable matter, and but slowly available, if at all, from hair, leather, hoofs, etc., hence some fertilizers that have the nitrogen furnished from the last-mentioned materials analyze better than they prove in use. For this reason the manufacturer should state from what material he manufactured his goods or the constituent parts. Ammonia and nitric acid are the results of the alteration of organic nitrogen. They can be purchased as sulphate of ammonia, or as nitrate of soda. Seventeen parts of ammonia, or sixty-six parts of pure sulphate of ammonia, contain fourteen parts of nitrogen. Eight-five parts of nitrate of soda contain fourteen parts of nitrogen. Nitrogen is estimated at a value of seventeen cents per pound.

Soluble Phosphoric Acid implies that it is soluble in pure water. This is readily dissolved by the rain and distributed in the soil, that it may be taken up by plants. Its application requires great care, that it may be distributed so as not to be too strong in places. If so, the rootlets of plants are injured and full benefit is not derived. Estimated value, eight cents per pound.

Reverted Phosporic Acid means that it was once fully soluble in water, but from chemical change has become insoluble in pure water, yet experiment shows it is in the impure water, contained in our soils, but not as rapidly as if soluble. It is supposed that the soluble becomes reverted in our soil after having been dissolved, and then is more uniform in its availability. If so, the reverted acid is more valuable than the strickly soluble, as its application is less difficult and the danger of injury lessened. In this condition it is freely taken up by a strong solution of ammonium citrate, which is therefore used to determine its quantity. Those who claim it is not so valuable for fertilizing, claim that it is not so easily distributed by rain. Estimated value, seven and one-half cents per pound—though we believe it is equally valuable with soluble and should be estimated at the same price.

Insoluble Phosphoric Acid.—This is phosphate of lime as in bones, or as found in the phosphate beds of South Carolina, or the apatite rock of Canada. It is to coarse and compact to be dissolved either by water ar ammonium citrate. If it is reduced to a very fine powder it is, however, available, and if as fine as the reverted which has been made so by being once dissolved, we see no reason why it should not be as good as the reverted. We find by experience that bone-dust, or the mineral when very fine, is truly available and we believe the farmer will by and-by use it almost entirely in this way. Now valued from two cents per pound in the fine ground rock, to seven cents in bone dust, as it has been found by experiment that it becomes available in the soil much more readily than at first supposed. As the insoluble is generally in coarse bone it is figured at three cents per pound.

Potash.—This is the fertilizing ingredient in wood ashes, and the base of various potash salts. It is most costly as a sulphate, value seven cents per pound, and cheapest as a muriate or chloride, value four and one-fourth cents per pound. As in superphosphates, estimated at four and one-half cents.

The foregoing are the ingredients from which the valuable part of the fertilizers sold are made up, though these desirable potions are, of course, obtained from material in its crude condition much cheaper than at market rates. This is the legitmate profit of the manufacturer, as the farmer would usually be compelled to buy in market. It is, however, desirable for any farmer to do so, when he can make a saving thereby. If he cannot buy the compound desired, he must prepare it himself or meet with loss. Let no farmer be afraid to test the capabilities of his land, as he may, and usually can, as a result get much larger profits.

ESTIMATION.

The estimated value of fertilizers, analyzed can be readily found by multiplying the number of pounds in a ton, as found from percentage, by the price per pound, as given above, and adding the results obtained from the different multiplications together. This shows a very great difference in their worth and is well worthy the attention of farmers when they are about to purchase.

The following tables show the estimated values of all the superphosphates sold in the state for two years past; also the amount of the various useful ingredients in a ton of the same. It is well to look them over carefully before purchasing; though this does not show the actual value to the purchasers, it approximates to it.

No. 1.

Soluble Pacific Guano, manufactured by the Pacific Guano Co., Boston, Mass.

Valuable Ingredients.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	2.32	46.40	$7.88
Soluble phosphoric acid	6.88	137.60	11.00
Reverted phosphoric acid	1.56	31.20	2.34
Insoluble phosphoric acid	1.98	39.60	1.18
Potash	3.28	65.60	2.95
Estimated value			$25.35

No. 2.

Bowker's Hill and Drill Phosphate, manufactured by the Bowker Fertilizer Co., Boston, Mass.

Nitrogen	3.16	63.20	10.74
Soluble phosphoric acid	6.28	125.60	10.24
Reverted phosphoric acid	2.09	41.80	3.13
Insoluble phosphoric acid	2.69	53.80	1.61
Potash	2.79	55.80	2.51
Estimated value			$28.03

No. 3.

Stockbridge Manure, manufactured by the Bowker Fertilizer Co., Boston, Mass.

Nitrogen	3.47	69.40	11.79
Soluble phosphoric acid	6.62	132.40	10.59
Reverted phosphoric acid	1.96	39.20	2.94
Insoluble phosphoric acid	1.57	31.40	.94
Potash	4.05	81.00	3.64
Estimated value			$29.90

No. 4.

Bradley X. L. Superphosphate, manufactured by the Bradley Fertilizer Co., Boston, Mass.

Nitrogen	2.39	47.80	8.12
Soluble phosphoric acid	8.12	162.40	12.99
Reverted phosphoric acid	1.54	30.80	2.31
Insoluble phosphoric acid	1.17	23.40	.70
Potash	2.55	51.00	2.29
Estimated value			$26.41

No. 5.

Bradley's Patent Phosphate, manufactured by the Bradley Fertilizer Co., Boston, Mass.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	2.27	45.40	$7.71
Soluble phosphoric acid	6.97	139.40	11.15
Reverted phosphoric acid	1.88	37.60	2.82
Insoluble phosphoric acid	2.32	46.40	1.39
Potash	2.59	51.80	2.33
Estimated value			$25.40

No. 6.

B. D. Sea Fowl Guano, manufactured by the Bradley Fertilizer Co., Boston, Mass.

Nitrogen	2.06	41.20	7.00
Soluble phosphoric acid	8.55	171.00	13.68
Reverted phosphoric acid	1.92	38.40	2.88
Insoluble phosphoric acid	1.39	27.80	.83
Potash	2.01	40.20	1.80
Estimated value			$26.19

No. 7.

Original Coe's Superphosphate, manufactured by the Bradley Fertilizer Co., Boston, Mass.

Nitrogen	2.34	46.80	7.95
Soluble phosphoric acid	8.15	163.00	13.04
Reverted phosphoric acid	1.94	38.80	2.91
Insoluble phosphoric acid	1.19	23.80	.71
Potash	1.35	27.00	1.21
Estimated value			$25.82

No. 8.

Quinnipiac Phosphate, manufactured by the Qunnipiac Fertilizer Co , New London, Conn.

Nitrogen	2.93	58.60	9.96
Soluble phosphoric acid	4.83	96.60	7.72
Reverted phosphoric acid	3.70	74.00	5.55
Insoluble phosphoric scid	2.73	54.60	1.63
Potash	2.46	49.20	2.21
Estimated value			$27.07

No. 9.

Quinnipiac Potato Phosphate, manufactured by the Quinnipiac Fertilizer Co., New London, Conn.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	2.32	46.40	$7.88
Soluble phosphoric acid	4.04	80.80	6.46
Reverted phosphoric acid	1.55	31.00	2.32
Insoluble phosphoric acid	0.94	18.80	.56
Potash	4.86	97.20	4.37
Estimated value			$21.59

No. 10.

Bay State Bone Superphosphate of Lime. manufactured by J. A. Tucker & Co., Boston, Mass.

Nitrogen	2.56	51.20	8.70
Soluble phosphoric acid	7.42	148.40	11.87
Reverted phosphoric acid	1.24	24.80	1.86
Insoluble phosphoric acid	0.87	17.40	.52
Potash	0.64	12.80	.57
Estimated value			$23.52

No. 11.

Bay State, manufactured by the Clark's Cove Guano Fertilizer Co., New Bedford, Mass.

Nitrogen	3.08	61.60	10.47
Soluble phosphoric acid	9.09	181.80	14.54
Reverted phosphoric acid	1.13	22.60	1.69
Insoluble phosphoric acid	1.12	22.40	.67
Potash	3.11	62.20	2.79
Estimated value			$30.16

No. 12.

Buffalo Ammoniated Bone Superphosphate, manufactured by the L. L. Crocker Fertilizer Co., Buffalo, N. Y.

Nitrogen	3.10	62.00	10.54
Soluble phosphoric acid	8.14	162.80	13.02
Reverted phosphoric acid	1.45	29.00	2.17
Insoluble phosphoric acid	0.58	11.60	.34
Potash	1.87	37.40	1.68
Estimated value			$27.75

No. 13.

Buffalo Superphosphate for Potatoes, Hops and Tobacco, manufactured by the L. L. Crocker Fertilizer Co., Buffalo, N. Y.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	3.10	62.00	$10.54
Soluble phosphoric acid	7.82	156.40	12.51
Reverted phosphoric acid	1.39	27.80	2.08
Insoluble phosphoric acid	1.04	20.80	.62
Potash	4.37	87.40	3.93
Estimated value			$29.68

No. 14.

Buffalo Superphosphate No. 2, manufactored by the L. L. Crocker Fertilizer Co., Buffalo, N. Y.

Nitrogen	0.00	00.00	00.00
Soluble phosphoric acid	6.36	127.20	10.17
Reverted phosphoric acid	4.58	91.60	6.87
Insoluble phosphoric acid	1.74	34.80	1.04
Potash	0.96	19.20	86
Estimated value			$18.94

No. 15.

Queen City Superphosphate, manufactured by the L. L. Crocker Fertilizer Co., Buffalo, N. Y.

Nitrogen	1.71	34.20	5.81
Soluble phosphoric acid	6.29	125.80	10.06
Reverted phosphoric acid	1.89	37.80	2.85
Insoluble phosphoric acid	1.74	34.80	1.04
Potash	1.54	30.80	1.38
Estimated value			$21.14

No. 16.

Homestead Superphosphate, manufactured by the Michigan Carbon Works Fertilizer Co., Detroit, Mich.

Nitrogen	2.25	45.00	7.65
Soluble phosphoric acid	7.50	150.00	12.00
Reverted phosphoric acid	1.57	31.40	2.35
Insoluble phosphoric acid	1.70	34.00	1.02
Potash	1.21	24.20	1.08
Estimated value			$24.10

No. 17.

Orient Complete Manure, manufactured by the Atlantic and Virginia Fertilizer Co., Elizabethtown, N. J.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	1.95	39.00	$6.63
Soluble phosphoric acid	6.35	127.00	10.16
Reverted phosphoric acid	3.81	76.20	5.71
Insoluble phosphoric acid	0.78	15.60	.46
Potash	1.16	23.20	1.04
Estimated value			$24.00

No. 18.

Americus, manufactured by the Wm. Clark & Co. Fertilizer Co., New York, N. Y.

Nitrogen	3.34	66.80	11.35
Soluble phosphoric acid	7.83	156.60	12.52
Reverted phosphoric acid	1.01	20.20	1.51
Insoluble phosphoric acid	1.60	32.00	.96
Potash	3.01	60.20	2.70
Estimated value			$29.04

No. 19.

Slack Dissolved Bone, manufactured by the Slack Fertilizer Co., Springfield, Vt.

Nitrogen	3.46	69.20	11.76
Soluble phosphoric acid	2.77	55.40	4.43
Reverted phosphoric acid	2.60	52.00	3.90
Insoluble phosphoric acid	4.08	83.60	2.44
Potash	5.79	115.80	5.21
Estimated value			$27.74

No. 20.

Slack's Champion Bone Phosphate, manufactured by the Slack Fertilizer Co., Springfield, Vt.

Nitrogen	3.16	63.20	10.74
Soluble phosphoric acid	2.68	53.60	4.28
Reverted phosphoric acid	2.44	48.80	3,66
Insoluble phosphoric acid	5.58	111.60	3.34
Potash	5.95	119.00	5.35
Estimated value			$27.37

No. 21.

Cumberland Superphosphate, manufactured by the Cumberland Bone Co Fertilizer Co., Portland, Me.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	2.34	46.80	$7.95
Soluble phosphoric acid	7.78	155.60	12.44
Reverted phosphoric acid	1.44	28.80	2.16
Insoluble phosphoric acid	1.32	26.40	.79
Potash	3.69	73.80	3.32
Estimated value			$26.66

No. 22.

Bradley's Ammoniated Dissolved Bone, manufactured by the Bradley Fertilizer Co., Boston, Mass.

Nitrogen	1.53	30.60	5.20
Soluble phosphoric acid	9.96	199.20	15.93
Reverted phosphoric acid	1.17	23.40	1.75
Insoluble phosphoric acid	1.13	22.60	.67
Potash	1.95	39.00	1.74
Estimated value			$25.29

No. 23.

Quinnipiac Pine Island Phosphate, manufactured by the Quinnipiac Fertilizer Co., New London, Conn.

Nitrogen	2.71	54.20	9.21
Soluble phosphoric acid	8.49	169.80	13.58
Reverted phosphoric acid	1.21	24.20	1.81
Insoluble phosphoric acid	0.81	16.20	.48
Potash	1.42	28.40	1.27
Estimated value			$26.35

No. 24.

Ammoniated Bone, manufactured by the Russel Coe Fertilizer Co., New York, N. Y.

Nitrogen	1.34	26.80	4.55
Soluble phosphoric acid	4.96	99.20	7.93
Reverted phosphoric acid	2.58	51.60	3.87
Insoluble phosphoric acid	7.69	153.80	4.61
Potash	1.61	32.20	1.44
Estimated value			$22.40

No. 25.

Common Sense Fertilizer No. 2, manufactured by the Common Sense Fertilizer Co., Boston, Mass.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	1.76	35.20	$5.98
Soluble phosphoric acid	0.84	16.80	1.34
Reverted phosphoric acid	2.45	49.00	3.67
Insoluble phosphoric acid	5.52	110.40	3.31
Potash	3.55	71.00	3.19
Estimated value	......	......	$17.49

No. 26.

Common Sense Fertilizer D, manufactured by the Common Sense Fertilizer Co., Boston, Mass.

Nitrogen	1.09	21.80	3.70
Soluble phosphoric acid	trace	......	....
Reverted phosphoric acid	0.95	19.00	1.42
Insoluble phosphoric acid	2.46	49.20	1.47
Potash	0.84	16.80	.76
Estimated value	......	......	$7.35

No. 27.

Listers' Standard Phosphate, manufactured by the Lister Brothers Fertilizer Co., Newark, N. J.

Nitrogen	2.14	42.80	7.27
Soluble phosphoric acid	9.12	182.40	14.59
Reverted phosphoric acid	2.27	45.40	3.40
Insoluble phosphoric acid	2.11	42.20	1.26
Potash	1.99	39.80	1.79
Estimated value	......	......	$28.31

No. 28.

Listers' Ammoniated Dissolved Bone Phosphate, manufactured by the Lister Brothers Fertilizer Co., Newark, N. J.

Nitrogen	1.57	31.40	5.33
Soluble phosphoric acid	8.01	160.20	12.81
Reverted phosphoric acid	1.94	38.80	2.91
Insoluble phosphoric acid	0.85	17.00	.51
Potash	2.13	42.60	1.91
Estimated value	......	......	$23.47

No. 29.

Listers' Potato Fertilizer, manufactured by the Lister Brothers Fertilizer Co., Newark, N. J.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	4.47	89.40	$15.19
Soluble phosphoric acid	8.23	164.60	13.16
Reverted phosphoric acid	0.68	13.60	1.02
Insoluble phosphoric acid	0.77	15.40	.46
Potash	7.54	150.80	6.78
Estimated value	......	......	$36.61

No. 30.

Dole's Fertilizer No. 1.—203, *for all crops, manufactured by Dole Fertilizer Co., Boston, Mass.*

Assay by Prof. S. P. Sharples.

Nitrogen	2.44	48.80	8.29
Soluble phosphoric acid	4.99	99.80	7.98
Reverted phosphoric acid	4.78	95.60	7.17
Insoluble phosphoric acid	.75	15.00	.45
Potash	3.88	77.60	3.49
Estimated value	......	......	$27.38

No. 31.

E. Frank Coe's High Grade Superphosphate, manufactured by the E. Frank Coe Fertilizer Co , New York, N. Y.

Nitrogen	2.15	43.00	7.31
Soluble phosphoric acid	8.50	170.00	13.60
Reverted phosphoric acid	2.67	53.40	4.00
Insoluble phosphoric acid	2.25	45.00	1.35
Potash	1.59	31.80	1.43
Estimated value	......	......	$27.69

No. 32.

Buffalo Special Superphosphate, manufactured by Smith & Becker. Trustees, Buffalo Fertilizer Co., Buffalo, N. Y.

Nitrogen	1.59	31.80	5.40
Soluble phosphoric acid	8.48	169.60	13.56
Reverted phosphoric acid	1.70	34.00	2.55
Insoluble phosphoric acid	.47	9.40	.28
Potash	2.92	58.40	2.62
Estimated value	......	......	$23.41

No. 33.

Fish and Potash, manufactured by Wm. I. Brightman & Co. Fertilizer Co., Tiverton, R. I.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	3.09	61.80	$10.50
Soluble phosphoric acid	2.57	51.40	4.11
Reverted phosphoric acid	1.24	24.80	1.86
Insoluble phosphoric acid	3.81	76.20	2.28
Potash	3.16	63.20	2.68
Estimated value	......	......	$21.43

No. 34.

Common Sense No. 1, *manufactured by the Common Sense Fertilizer Co., Boston, Mass.*

Nitrogen	1.76	35.20	5.98
Soluble phosphoric acid	......	......	....
Reverted phosphoric acid	2.13	42.60	3.19
Insoluble phosphoric acid	3.87	77.40	2.32
Potash	3.32	66.40	2.98
Estimated value	......	......	$14.47

No. 35.

Darling's Animal Fertilizer, manufactured by the L. B. Darling Fertilizer Co., Pawtucket, R. I.

Assay by Prof. C. A. Goessman.

Nitrogen	3.30	66.00	11.22
Soluble phosphoric acid	0.34	6.80	.54
Reverted phosphoric acid	2.36	47.20	3.54
Insoluble phosphoric acid	8.38	167.60	5.02
Potash	3.94	78.80	3.54
Estimated value	......	......	$23.86

No. 36.

Flamingo Guano, manufactured by Flamingo Guano Co., Baltimore, M. D.

Assay by Prof. C. A. Goessman.

Nitrogen	0.80	16.00	2.72
Soluble phosphoric acid	0.48	9.60	.76
Reverted phosphoric acid	5.22	104.40	7.83
Insoluble phosphoric acid	10.47	209.20	6.27
Potash	0.31	6.20	.27
Estimated value	......	......	$17.85

No. 37.

Dole's Fertilizer No. 2, Special Potato, manufactured by Dole Fertilizer Co., Boston, Mass.

Assay by Prof. S. P. Sharples.

VALUABLE INGREDIENTS.	Per cent.	Pounds in a Ton.	Value by Common Standard.
Nitrogen	2.52	50.40	$8.56
Soluble phosphoric acid	4.99	99.80	7.98
Reverted phosphoric acid	5.09	101.80	7.63
Insoluble phosphoric acid	.70	14.00	.42
Potash	4.90	98.00	4.41
Estimated value			$29.00

Nos. 30, 35, 36, and 37, did not understand, or undertook to evade our law, hence the analysis by Goessman, and Sharples, instead of Cooke, as after they adjusted the license there was no time to analyze the samples.

OUR HOMES.

In one of the most elevated villages of New England, twelve hundred ten feet above sea level, is our home, and at about the same height and higher is the land we cultivate. The view is a very fine one. The White Mountain range with its bold summits skirts the horizon from the East to the South-west, the peaks being scarcely more than twenty-five miles distant. Fogs or mosquitoes we do not have, as they seldom reach so high an altitude, but pure water from springs is abundant on every hand, yet drainage is easy, for it is all side-hill. Such a place I have chosen for my home, and I would that there were no worse localities. Yet this almost model locality is not free from disease and death. Still the land is productive and we have pure air, pleasant sunshine, and not overmuch wind. It is true there are hundreds of similar localities in Vermont. But I believe the first step toward long life and happiness is to be satisfied with our home, as contentment fortifies the possessor against disease; yet we will follow Dr. G. A. Bowen, as we point out other links in the chain that bind all alike in this world, hoping that some may improve their surroundings by consideration of the subject. Others become more contented as they feel safety and immunity in their nearly faultless surroundings.

Physiology and hygiene teach us that perfect health, robust and vigorous constitutions can be obtained and maintained only through the instrumentality of nourishing foods, pure air, bright sunlight and long periods of undisturbed and refreshing sleep, together with suitable mental and physical exercise, living in accordance with nature, and not with the dictates of fashion, thus training ourselves for an artificial existence. Where and in what avocation can these conditions be so completely carried out as upon the farm? For here is raised the major portion of the foods that support the human race, and the production of them compels the tiller of the soil to pass the working hours of the day in the pure air and invigorating sunshine, exercising his muscles by carrying out the dictates of a previously exercised mind. The work of the farm compels no labor during the hours of the night, hence sleep, "nature's sweet restorer," need not be interfered with. The farm, then, possessing all the requisites for health, should give us the strongest, soundest and most vigorous and long-lived class in the community; and, judging by conditions by *a priori* reasoning, the farmer should be a model of manly health and beauty, tall and sinewy and by reason of air, food and exercise, deep-chested and full-blooded. His frame should be an illustration of physical perfection, disclaiming all knowledge of disease, and his face a fitting crown therefor, made perfect by thoughtful and intelligent observation, study and reasoning. To this class should the artist look for his example of a Hercules or an Adonis. To repeat, the conditions for this physical perfection, the means that lead to it, are in greater perfection on the farm than in the office, store or work-shop.

But experience shows that it is not true, as too many of our farm homes lack the proper requisites of comfort. In fine, the average farm-house is far from being perfect in its sanitary conditions.

SHADE TREES.

How few homes have shade trees properly placed around them! Yet no home is quite complete without the aid of trees and shrubbery, which serve to cool the fervid heats of summer, and screen as well from the wintry blasts, besides lending a cheerful coziness to the place, which makes it truly a home. But how often are all of these purposes changed by a want of thought regarding their positions! They are frequently placed so as to completely shade the house, rendering its air damp and unwholesome from the mould and decay silently going on, which as silently but as surely extend to the minds and bodies of the inmates; for in a decaying house there will be decaying bodies, and in such how can there be anything, so to speak, but mouldy and decaying minds? Put trees near the house, but not so near but that the sun will shine upon it sometime during the day, giving it the benefit of its chemistry. Let its light in through the windows, and not obstruct it by shrubs. They are for ornamenting your grounds, and not for burying the dwelling in seclusion and gloom. Besides, their appearance is greatly enhanced by standing by themselves, or artistically grouped in positions away from the house, and not immediately under the eaves. If it is desired that a bare wall should be covered, or a doorway porch made shady and attractive, vines can be used to far better advantage. The sun can penetrate their light foliage enough to dry it, and their numerous rootlets, by which they cling to their support, will absorb moisture rather than harbor it, giving the full object desired by shade—a cool, dry atmosphere.

OUTBUILDINGS HANDY.

We may also notice that a desire for convenience—having things handy, as it is termed—has in many instances been made an excuse for laziness, or shows gross ignorance on the part of the owner, and one is fully as reprehensible as the other in the grouping and arrangement of the out buildings. The barn, with its cattle-yard, the pig-pen and poultry-house, the privy and the well, all seem to be striving to show the most sociability for the kitchen door, filling the air with ill odors and the soil with filth and fever germs, to be carried into the well with every permeating rain. I would advise you to have an eye to them all, and, if you can view them from the standpoint we are occupying, sweep them away as you would a murderer or seducer who was trying to rob you of the fair members of your family; for pure water is as necessary to good health as morality is to godliness.

INTERIOR OF THE FARM HOUSE.

The interior of the farm house, as a general thing, has about as many objections, when considered as aids to disease, as the exterior. New England houses, as a rule, I have found to be well ventilated, excepting, perhaps, certain portions. This is not due so much, however, to the ingenuity of the builder as it is to the force of the wind, which will not be kept out. A principal exception is the cellar, and oh, farmer, if you are not guilty of the other omissions that I have pointed out, I am afraid that you are here, for it does seem to me that the accumulations of the produce of the farm that are stored therein and allowed to remain late into the summer, until they sicken your wife and your children, should make you sick of the expense of doctors' bills at least.

Cellars,as a rule, are not well drained, and are consequently damp, and all more or less dark, thus precluding cleanliness, giving rise to the very conditions best adapted to the propagation of disease germs. If one will have a cellar under the house have it well drained, and its walls and floors cemented. With an outside drain around the house to prevent the saturation of the soil, it may be kept dry. The cellar should be partly above ground to allow of windows to admit air and light.

THE SLEEPING-ROOM.

It is safe to say that two-thirds of the Vermont farmers, when they retire to-night will do so in a room on the ground floor, perhaps on the north side of the house and over the cellar. One window is closely screened, the bed placed against it, precluding its use, the other opens upon an almost grassless corner of the ground, made rank and noisome by the shade of an apple or other tree, intensified by the addition of a rampant growing woodbine, making in summer a capital place for the boys to dig their bait when they go a fishing, and in winter a reservoir for ice cold air, conducive to pneumonia and rheumatism. Why not use the best and most cheerful room in the house, instead of stealing away to such a place resembling the cell of a criminal? The best room in the house is not too good for the farmer. He owns it, and by his day of toil has earned a further right to its comforts and benefits; and we firmly believe that he would not only feel happier, brighter and stronger for it, but also that his "doctor's bill" at the end of the year would be far smaller. As it is, if he closes the window he feels suffocation, and so he usually opens it and admits the pestilential night air. He had many times better sleep in a healthful locality outdoors. But, say some, in imaginary horror, don't we need ventilation? Yes; but this is not ventilation. It is the admission of the cold, damp, unhealthful night air upon you, so that one side chills while the other is warm. It admits the draft spoken of by Prof. Angus Smith, which he says is more deadly than the sword. Ventilation is one thing needful, and, where not prepared for in building, may be secured by raising the sash four inches and placing under it a close fitting piece of board,stopping entirely the chance of a draft, and the upward current of air between the glass and sash shows you the way outside air should be admitted. A grate into your chimney, where you formerly had a fire-place, is the way impure air should be let out.

Open fires in stoves are good ventilators, but air-tight stoves without ventilation are costly pets.

Allow us here to say that warming an upper room with the heated and vitiated air of the room below it by means of a register, is false economy; better bring the stove-pipe through the ceiling and into a drum, which will utilize the heat which otherwise escapes into the chimney, and which will give a temperature sufficient for all purposes for which such an upper room is used.

Healthful arrangements for the lighting, heating and drainage of houses should never be objected to on the score of expense, as we have repeatedly heard them. No argument from us is necessary to show that vigorous health is of more importance than dollars and cents. But really these sanitary measures are far less expensive than the old way of living. The saving of the items of expense of one illness alone would be enough to re-arrange the whole place for a complete sanitarium. All that is required is a little thoughtful consideration, a little brain-work, all of which is within the power of him who successfully tills Vermont soil.

FOOD.

Is the farmer's diet a perfect one for the labor required of him? and is the boasted New England cooking the best method of rendering available the nutritive properties of that food? Without attempting to show the scientific classification of food, and all its details, which is an extensive study in itself, we will pass at once to the character of the food supply of the farm, and we find that nowhere else is there such a variety presented for the selection of any one man, or class of men. The beef, veal, mutton, lamb, pork, poultry and egg supply of the whole country is produced of course upon the farm; it belongs to the farmer, and he can make his selection from it before it leaves him. So also with regard to grains and vegetables which render the city markets so attractive. The long list of meats, vegetables and fruits and the products of the dairy that are shown by some farms, is simply astonishing. They show a complete food, possessing all necessary elements required by the demands of the system. In addition to the articles mentioned, some of the more modern farms can show their carp and trout ponds, stlll further augmenting the list. So, then, we see that the farmer can have the best food of the land. Does he make use of it for his table? No: he sells it. I know that he must have cash to meet his obligations, and that it must come from the products of the farm, which is business-like and right. But would it not be well to divide things a little? Instead of selling all the meat products except pork, would it not be better to dispose of a portion of that, and retain some of the others, thus giving a variety to the diet? The cash returns for an average of years would be the same, and the satisfaction and welfare of the family greater. But some one says, my farm does not show such an array as has been enumerated, so I am counted out. But can it not be made to produce more of a variety than it does? A little systematic planning here will tell. Sell less hay, or better yet, none at all; keep more cattle and sheep, and consume it at home, thus maintaining the fertility of the land, the plethora of the pocket-book and having the satisfaction of "a good square meal" at regular intervals. Cannot the garden also be made to yield more of a variety and support? Perhaps we had better not speak of a farmer's garden. You will accuse us of being too personal. We have noticed that some farmers appear reticent on the subject of their garden, which has led us sometimes to think that they did not have any. The farmer does not eat vegetables enough. Potatoes are the only ones that he habitually indulges in. If he raises others he markets them, and confines himself to the unvarying round of pork, potatoes and pastry.

This is not as it should be. Every farmer's household should have the best of food and fruits in abundance, and all should be eaten at meal-time; not now and then, all day, as is so often the case. The dessert at the table should be fruit, not pies and cakes. The worth of all fruit is much injured by the cooking. No people are so wedded to pie as New England farmers. You can tell that he belongs to New England anywhere by that propensity, as well as you can tell a German by his beer.

THE FARMER'S FAMILY.

It is not the health of the farmer alone that claims our attention to-day, but also that of his family. First, the farmer's wife—what is her status as regards health? She does not take as high a stand as her husband does; facts carry out what the natural supposition would be. Her labor is more incessant and of a far more vexatious character, is performed within doors, away from the exhilarating effects of air and sunshine, and she receives less stimulus from her surroundings; add to this the bearing and rearing of children, and labors that she is obliged to perform when the functions of her system require rest, and one can readily see that it must rank lower.

It has always been an enigma to us why any woman would marry a farmer. You may in turn express surprise why they will a physician, but they do both, inscrutable as it may seem. I have known the farmer to select his wife as he would a mate for his horse, for the amount of labor that she could perform, freely questioning with his neighbors if she were able to keep her whiffletree even with his, as they drew the burden of labor, tender regard and love having a subordinate place. Think what the farmer's wife does for him when he brings her to his dwelling and she commences the fulfillment of her duties. From that time on she does, for him and the hired men, the cooking, the washing and mending, makes many of her husband's garments and all of her own, and those of her children as they successively appear, attends to the dairy, and on some few farms feeds the pigs and poultry, and lugs in wood and water for the household purposes. Is it any surprise that Nature soon exhausts herself and the woman dies? Did you ever think how many among your own acquaintances are living with their second or third wife? Compare it with the converse and you will be surprised at the different results.

What killed the woman? The certificate of her death filed with the town clerk will give the scientific name of the disease that was the immediate cause, and at the funeral the minister doubtless said it was one of the mysterious dispensations of Providence. But I tell you that, back of it, was the toil of years, cheered with but few comforting words and sympathies; broken down before her time that the mortgage might be paid, or the little fund in the bank increased. Where was the comfort of her life? Did she go anywhere? Did she see friends? Did she have books and opportunities to read them? Was her mental capacity increased, and her life made progressive and better fitted for an eternal hereafter, by the years that she spent as that man's wife? Forbid that it should ever be repeated, and yet it is to-day, at this very hour, thoughtlessly, perhaps, in many intances, but nevertheless as effectually. Life's early dreams and hopes, the accomplishments learned in maidenhood, even ambition itself, are swallowed up by the mighty maelstroom of work that ruins her health, inflicts keen suffering, and finally demands life itself—work that should have been, much of it, performed by men.

There is a bright picture in the children of the farm. They are the robust and vigorous little specimens that one would wish to see. Strong and well developed, possessed of inquiring minds and happy dispositions, with good digestive powers, assimilating their food well, and consequently laying the foundation for future mental and physical strength, presenting,in the sum total, quite a contrast to the children reared within the limits of the cities. This is just what we should expect from the premises that we have assumed for free exercise within the limits of their strength, performed in the open air and sunshine. The food largely composed of milk and fruit, and the long periods devoted to sleep, are just the conditions for perfect health.

Why should they not be kept so?

God speed the time when woman shall everywhere have the same rights of control that man has. She will then change some of the ills of our present conditions of life.

As it is, life is to her anything but desirable, and you will pardon me by annexing for your careful consideration the life pictures drawn by Mrs. Rose Terry Cooke, of the

TWO MRS. TUCKERS.

"You can make the fire while I put the hoss out," said Amasa Tucker, as he opened the back door of a gray house, set on top of a treeless hill, tracked here and there with the paths the geese had made in their daily journeys to the pond below, and only approached at the back by a lane to the great red barn, and a rickety board gate set between two posts of the rail fence.

This was Wealthy Ann Tucker's home-coming. She had married Amasa that morning at her father's house in Stanton, a little village twenty miles away from Peet's Mills, the town within whose wide limits lay the Tucker farm; and had come home with him this early spring-afternoon in the old wagon, behind the bony horse that did duty for Amasa's family carriage.

Mrs. Tucker was a tall, thin young woman, with a sad reticent face, very silent and capable; these last traits had been her chief recommendation to her husband. There was no sentiment about the matter. Old Mrs. Tucker had died two weeks before this marriage, but Amasa was "forehanded," and knowing his mother could not live long, had improved his opportunities and been "sparkin" Wealthy Ann Miner all winter, in judicious provision for the coming event of his solitude.

He had thought the thing all over, and concluded that a wife was cheaper than a hired girl, and more permanent; so when he found this alert, firm-jointed, handy girl living at her uncle's, who was a widower on a great farm on the other side of the village, Amasa made her acquaintance as soon as possible, and proceeded to further intimacy. Wealthy liked better to work for her uncle than for a step-father with six children, but she thought it would be better still to have a house of her own; so she agreed to marry Amasa Tucker, and this was her home-coming.

She opened the the door into a dingy room with an open fire-place at one end, a window on the north and one on the south side, small paned with old, green, and imperfect glass, and letting in but just enough light to work by. One corner, to the north, was partitioned off to make a pantry, and a door by the fire-place led out into the wood-shed. The front of the house contained two rooms. One opened into the kitchen and was a bedroom, furnished sparsely enough; the other was a parlor, with high-backed, rush-bottomed chairs against the wall, a round table in the middle, a fire-place with brass and irons, and fire-irons, a family Bible on the table, and a "mourning-piece" painted in ground hair on the mantel. Green paper shades and white cotton curtains, a rag carpet, fresh as it came from the loom—if its dinginess could ever be called fresh—and a straight-backed sofa covered with green and yellow glazed chints, made as dreary an apartment as could well be imagined. Wealthy shut the door behind her quickly, and went to the shed for material to make her fire. It was almost sundown, and she was hungry; but she found only the scantiest supply of wood, and a few dry chips for kindling. However, she did her best, and she had brought some provisions from home, so that she managed to lay out a decent supper on the rickety table by the time Amasa came stamping in from the barn.

He looked disapprovingly at the pie, the biscuit, the shaved beef, and the jelly set before him.

"I hope ye ain't a waster, Wealthy," he growled.

"There's vittles enough fur a township and the' ain't but two of us."

" Well, our folks sent'em over; and you no need to eat'em," she answered, cheerily.

" I ain't goin' to; don't ye break into that jell, set it by; sometime or nuther somebody may be a comin' here, and you'll want it."

Wealthy said no more; they made their supper of biscuit and beef, for the pie also was ordered " set by."

She was used to economy, but not to stinginess, and she excused this extreme thrift in her husband more easily for the reason she had been always poor, and she knew very well that he was not rich to say the least. But it was only the beginning.

Hard as Wealthy had worked at her uncle's, here she found harder burdens; she had to draw and fetch all the water she used from an old-fashioned well with a heavy sweep; picturesque to see, but wearisome to use. Wood was scarce, for though enough grew on the hundred acres that Amasa owned, he grudged its use.

"I shan't cut down no more than is reely needful," he said, when she urged him to fetch her a load; "wood's allers a growin' when ye don't cut it. and a makin' for lumber; and lumber's better to sell, a sight, than cord-wood. Ye must git along somehow with brush; mother used to burn next to nothin'."

She did not remind him that his mother was bent double with rheumatism, and died of the fifth attack of pneumonia. Wealthy never wasted words.

Then there were eight cows to milk, the milk to strain, set, skim, churn, or make into cheese, and nothing but the simplest utensils to do with. A cloth held over the edge of the pail served for a strainer; the pails themselves were heavy wood, the pans old, and some of them leaky, the holes stopped with bits of rag, often to be renewed; the milk room was in the shed, built against the chimney that it might not freeze there in winter, and only aired by one slatted window; the churn was an old wooden one with a dasher, and even the "spaddle" with which she worked her butter was whittled out of a maple knot by Amasa himself, and was heavy and rough.

Then to her belonged feeding of the the pigs—gaunt, lean animals with sharp snouts, ridgy backs, long legs and thin flanks, deep-set eyes that gleamed with intelligent malice, and never-sated hunger. Wealthy grew almost afraid of them when they clambered up on the rails of the pen in their fury for food and flapped their pointed ears at her, squealing and fighting for the scanty fare that she brought. For Amasa underfed and overworked everything that belonged to him.

Then there were hens to look after—the old-fashioned barn door "creepers," who wanted food too, and yet catered for themselves in great measure, and made free with barn and woodshed, for want of their own quarters, and were decimated every season by hawks, owls, skunks, weasels and foxes, to say nothing of the little chickens on which crows and cats worked their will, if they dared to stray beyond the ruinous old coop contrived for them by Amasa's inventive genius out of sticks and stones.

Add to all this the cooking, washing, baking and sewing, the insufficient supply of pork, potatoes, and tough pies, the "b'iled dinners" whose strength lay in the vegetables, rather than the small square of fat pork cooked with them, of which Amasa invariably took the lion's share: these accumulating and never ceasing labors all wore day by day on the vitality of Mrs. Tucker, and when to these were added an annual baby, life became a terror and a burden to the poor woman.

But what did Amasa care? He, too, worked from "sun to sun."

He farmed in the hard old fashion, with rude implements and no knowledge but—

"My father done it afore me so I'm a goin' to do it now; no use talking." One by one the wailing puny children were laid away in the little yard on top of the sandhill, where the old Tuckers and their half-dozen infants lay already: a rough inclosure full of mulleins, burdocks, and thistles, overrun with low blackberry vines and surrounded by a rail fence. It had been much handier for the Tuckers to have a grave-yard close by than to travel five miles to the Mills with every funeral: and they were not driven by public opinion in regard to monuments; they all lay there like the beasts that perish, with but one scant grey stone to tell where the first occupant left his tired bones. Two children of Wealthy's survived, Amasa and Lurana, the oldest and youngest of seven.

Amasa, a considerate, intelligent boy, who thought much and said little, and Lurana or "Lury" as her name was generally given, a mischievous, self-willed little imp, the delight and torment of her worn-out mother. Young Amasa was a boy quite beyond his father's understanding; as soon as he was old enough he began to help his mother in every way he could devise. And when his term at the village school was over, to his father's great disgust, he trapped squirrels and gathered nuts enough to earn his own money and subscribe for an agricultural paper, which he studied every week till its contents were thoroughly stored in his head. Then began that "noble discontent" which the philosophers praise.

The elder man had no peace in his old-world ways; the sloppy waste of the barn-yard was an eye-sore to this "book-learned feller," as his father derisively called him. And the ashes of the wood-fire were saved and sheltered like precious dust, instead of thrown into a big heap to edify the wandering hens. The desolate garden was plowed, fertilized and set in order at last, and the great ragged orchard manured, the apple trees thinned and trimmed, and ashes sown thick over the old mossy sod. Now these things were not done in a day or a year, but as the boy grew older and more able to cope with his father's self-conceit more was done annually, not without much opposition and many hard words, but still done.

Then came a heavy blow. Lurana, a girl of fifteen, fresh and pretty as a wild rose, and tired of the pinching economy, the monotonous work and grinding life of the farm, ran away with a tin peddler, and broke her mother's heart; not in the physical sense that hearts are sometimes broken, but the weary woman's soul was set on this bright, winsome child, and her life lost all its scant savor when the blooming face and clear young voice left her forever.

"I don't blame her none, Amasy," she sobbed out to her boy, now a stout fellow of twenty-two, raging at his sister's folly.

"I cant feel to blame her. I know 'tis more'n a girl can bear to live this way. I've had to, but it's been dreadful hard—dreadful hard! I've wished more'n once I could ha' laid down along with the little babies out there on the hill, so's to rest a spell; but there was you and Lury wanted me, and so my time hadn't come.

"Amasy, you're a man grown now, and if you should get married, and I s'pose you will—men folks seem to think it's needful, whether or no—do kinder make it easy for her, poor creetur! Don't grind her down to skin and bone like me, dear; 'tain't just right, I'm sure on't, never to make no more of a woman that ef she was a horned creetur; don't do it."

"Mother, I never will!" answered the son, as energetically and solemnly as if he were taking his oath.

But Wealthy was nearer to her rest than she knew; the enemy that lurks in dirt, neglect, poor food, constant drudgery, and the want of every wholesome and pleasurable excitment to mind and body, and when least expected swoops down and does its fatal errand in the isolated farm-house no less than in the crowded city slums, the scourge of New England, typhoid fever, broke out in the Tucker homestead.

Wealthy turned away from her weekly baking one Saturday morning just as the last pie was set on the broad pantry shelf, and fainted on the kitchen floor, where Amasa the younger found her an hour after, muttering, delirious and cold.

What he could do then, or the village doctor, or an old woman who called herself a nurse, was all useless; but the best skill of any kind would have been equally futile; she was never conscious again for a week; then her eyes seemed to see what was about her once more; she looked up at her boy, laid her wan cheek on her hand, smiled—and died.

Hardly had her wasted shape been put away under the mulleins and hard hack, when her husband came in from the hayfield smitten with the same plague. He was harder to conquer. Three weeks of alternate burning, sinking, raving and chills, ended at last in the grey and grim repose of death for him, and another Amasa Tucker reigned alone in the old house on the hill.

It is not to be supposed that in all these years Amasa the younger had been blind to the charms of other sex; he had not "been with" every girl who went to school with him, or whom he met at singing schools or spelling matches, or who smiled at him from her Sunday bonnet as he manfully "held up his end" in the village choir.

He had been faithful always to the shy, delicate, dark-eyed little girl who was his school sweetheart, and now it was to Mary Peet he hastened to ask her to share his life and home. He had intended to take a farm on shares the next summer, and work his way slowly upward to a place of his own; now he had this hundred-acre farm, and to his great suprise he found $3,000 laid up in the bank at Peet's Mills, the slow savings of his father's fifty years. He began at once to set his house in order; he longed to build a new one, but Mary's advice restrained him, so he did his best with this. The cellar he cleared and whitewashed with his own hands; cleaned its one begrimed window and set two more, so that it was sweet and light; the house was scrubbed from one end to the other; a bonfire made of the old dirty confortables and quilts; the kitchen repainted a soft yellow, and new windows, with clear, large glass, set in place of the dingy old sashes; the wood-house was filled with dry wood and a good store of pine cones and chopped brush for kindling. A new milk-room was built, but a little way from the back door, over a tiny brook that ran down the hill north of the house, and under the slatted floor kept up a cool draught of fresh air; a covered passage connected it with the kitchen, and a door into the old milk-room made of that a convenient pantry, while the removal of the old one from the kitchen corner gave to that apartment more air, room and light. A new stove, with a set boiler, filled up the hearth of the old fireplace; but further improvements Amasa left for Mary.

A different home-coming from his mother's she had indeed, on just such a spring day as Wealthy came there. The kitchen shone clean and bright, a bowl of pink arbutus blossoms made its atmostphere freshly sweet, and the fire was laid ready for her to light, the shining tea-kettle filled, and the pantry held such stores as Amasa's masculine knowledge of household wants could suggest; flour, butter, eggs, sugar, all were in abundance, and no feast of royalty ever gave more pleasure to its most honored guest than the hot biscuit Mary made and baked for their supper, the stewed dried apples, the rich old cheese, and the fragrant tea gave Amasa this happy evening. Next day they took their wedding trip to Peet's Mills in the new and sensible farm wagon Amasa had just bought, with a strong spirited horse to draw it.

"I want you should look around, Mary," he said the night before, "and see what is needful here. I expect most everything is wanting and we can't lay out for finery. But first of all get what'll make your work easy. Your wedding present will come along to-morrow; to-day we'll buy necessities."

Mrs. Peet had not sent her only girl empty-handed to the new house. A good mattress, two pairs of blankets, fresh, light comfortables, some cheap, neat, white spreads, a set of gay crockery, a clock, and a roll of bright ingrain carpeting had all come to the farm-house soon after the bride's arrival; her ample supply of sheets and pillow-cases, strong towels, and a few table-cloths had been sent the day before, so this sort of thing was not needed; but there was a new churn bought, and altogether new furnishings for the dairy, several modern inventions to make the work of a woman easier, a set of chairs, a table, and an easy lounge for the parlor, some cretone covered with apple blossoms and white thorn clusters, and pails, brooms, and tin-ware that would have made Wealthy a happy woman, crowded the over-full wagon before they turned homeward.

The old house began to smile and blossom under this new dispensation, and the new mistress smiled too.

Amasa milked the cows for her and lifted the heavy pails of milk to strain into the bright, new pans; he filled the woodbox by the stove twice a day, put a patent pump into the old well, and, as it stood above the house, ran a pipe down into a sink set in the woodshed, and so put an end to the drawing and carrying of water.

The fat, round, placid pigs, that now enjoyed themselves in the new pen he took care of himself.

"'Tain't work for women folks," he said.

"You've got enough to do, Mary; there's the garden you'll have an eye on, and the chickens, if you're a mind to; I'm going to build a hen-house and a yard to it right off, that'll be good enough for you as well as the chickens: and I want you should promise if any time the work gets a mite hefty and worries you, you'll speak right out. I can afford to have everything else worn out rather than my wife."

Really, it paid! It does pay, my masculine friends, to give any woman a kindly word now and then; if you had done it oftener, or your fathers had in the past, the rights of women never would have angered or bored you as they do now, or unsexed and made strident and clamorous that half of creation which is and always was unreasonable enough to have hungry hearts. Try it and see.

Amasa was wise above his generation; he had seen his mother suffer and learned a lesson. Mary never pined for kindly appreciation of her work, or help in it. When she had a door cut through into the parlor, the stiff chairs and sofa banished, the flowery curtains hung at either window, the gay carpet put down and the new furniture set in place, with her wedding present—an easy, stuffed rocker—drawn up to the table, on which lay two weekly papers and Harper's Magazine, she had still sense enough left to make this hitherto sacred apartment into a real sitting room, where every evening she and Amasa rested, read, or talked over the day's doings; and when the first fat, rosy baby came and Mary was about again, it added another pleasure to have the old cradle beside them all the evening with its sleeping treasure.

Can I tell in words what a sense of peace and cheer pervaded this household, in spite of some failures and troubles? If the rye did blast one year, and the two best cows die another; if a weasel once invaded the new and wonderful hen-house and slaughtered the best dozen Plymouth Rocks; if sweeping storms wet the great crop of hay on the big meadow, or an ox break its leg in a post-hole; still there was home to come back to, and a sensible, cheerful woman to look on the bright side of things when Amasa was discouraged.

But, on the whole, things prospered; and as Amasa heard the sweet laughter of his happy children, and met the calm smile of his wife, he could but look back on his mother's harassed and sad experience, and give a heartfelt sigh to the difference between the two Mrs. Tuckers, unaware how much it was due to his own sense of justice and affection.

There are two morals to this simple sketch, my friends: One is, the great use and necessity of taking an agricultural paper, and the other is the equal use and necessity of being good to your wives.

Accept which you like or need most. In the language of the ancient Romans: "You pays your money and you takes your choice."

MANUFACTURE OF BUTTER AND CHEESE

BY

THE NEW VACUUM PROCESS.

By Dr. Hiram A. Cutting.

During the past three years, there has been developed by a system of carefully conducted experiments an entirely new method of treating milk for the manufacture of butter and cheese, which may be destined to become of the greatest practical value to the dairy interest generally. The especial feature of this system, which distinguishes it entirely from all others, consists in treating milk with heat in vacuum. There were many difficulties in the way and obstacles to be overcome before the new system could be pronounced perfected, principal among which was the construction of an air-tight receiver of sufficient strength to resist the pressure of the outside air, and at the same time be simple and practical in its workings. Receivers are now built of iron or steel, either tin or porcelain lined, which are perfectly air-tight and in which milk may be set any length of time without absorbing any disagreeable flavor. The method of cooling the heated milk has also been greatly simplified. These receivers are built either singly or in pairs, and, having a capacity of 1000 to 2000 pounds each, are surrounded by a wooden jacket, with a space of three to five inches between it and the cylinder, for cold water and ice used in cooling the milk.

The vacuum process for treating milk to be used in butter and cheese making, in its present state of development, consists of the following machinery: A heating tank, one or more air-tight receivers, surrounded by an outside wooden jacket to contain cold water and ice, and an air-pump. The remaining machinery consists of cheese-vats, churns, and such other tools as are in use in ordinary factories. The receivers now in operation in the West, are built of tinned steel. They are cylindrical in form, nine feet in length by two feet in diameter, holding 1500 pounds of milk to work easily. They are furnished with an opening on top to receive the milk, sufficiently large to admit of easy cleansing, also with a brass faucet at the bottom for drawing off the milk and cream. Another small opening at the top connects with the air-pump, for the purpose of exhausting the air and pumping off noxious vapors arising from the milk. All these openings are fitted so as to close air tight, so that when filled with milk, and the pump has finished its work of exhausting the air, the milk remains in vacuum during the entire time that the cream is rising.

To treat milk by this process, on arrival at the factory it is conducted to the heating tank and there heated to between 100 and 150 degrees. From this it passes directly to the vacuum receivers. These, as fast as filled, are closed air tight, and a valve connecting them with the air-pump is opened, and the air and vapors arising from the milk are drawn off. When a vacuum of twenty-seven to twenty-eight inches by the barometer, bas been reached, the valve is closed and the milk remains in vacuum until the cream has risen. At the same time, cold water and ice are let into the wooden jacket surrounding the cylinders,and the temperature is quickly lowered to about forty-five degrees. By this sudden cooling, the pressure of the air being removed, all the cream rises very quickly. When this has been accomplished, the milk is drawn off through the brass faucet at the bottom to the cheese-vat to be made into cheese. As soon as the cream starts, the conductor is changed to the churn or cream-vat, and the cream entirely drawn off. The receivers are then thoroughly cleansed and rinsed, when they are ready for use as before.

CLAIMS.

It is claimed for the vacuum process, first that as large a yield of butter can be obtained as by any other process. Second, that a finer quality can be produced than by any other method. All unpleasant odors and gases having been pumped from the milk, it possesses a fineness and delicacy of flavor that can be acquired in no other way. By reason of the butter globules being unbroken, its texture and keeping qualities are unsurpassed. In this respect it differs essentially from centrifugal butter, in which the fatty globules are so bruised and broken by their rapid passage through the milk, that, when churned, the butter is soft and salvy in texture and loses its flavor quickly.

The skim-milk, by being treated in vacuum, when set with rennet for making into cheese, will be found to yield a much larger percentage of cheese and that of better quality than ordinary skim-milk. This is owing to the fact that a considerable portion of the highly soluble caseine or other nitrogenous matter, which usually passes off in the whey, by the peculiar effect of the vacuum is rendered coagulable by the rennet and so retained in the cheese. Although this may seem incredible to some, still its truth has been proved beyond question by actual experiment many times repeated.

The quality of the cheese is also largely increased, it being soft and digestible and consequently salable. It is well known that cheese made from ordinary skim-milk, from which all the cream has been removed, is out of the market at the present time.

In the manufacture of full cheese the vacuum method is especially useful. Besides the fact that it prevents the occurrence of floating curds by pumping off the gaseous impurity, it increases the yield by rendering the albumen coagulable, which, in its turn, absorbs the surplus fat, thereby preventing the large loss of that material, which by the usual method passes into the whey-vat. Thus is secured an increase in yield and at the same time increase of quality; two points of vital importance.

The vacuum process is in successful operation in a large creamery in St. Charles, Ills., operated by Messrs. Pembleton & Oatman Bros., where both butter and cheese are manfactured. In the July No. of "The Dairy World" published in Chicago, is given an account of a visit to that factory to see the vacuum process in operation, by a party consisting of Col. McGlincy, Sec. of the Elgin Board of Trade, Messrs. Hintz & Frederickson Bros., chemists from New York State, from which we quote: "It is claimed that by this process they not only get all the butter out of the milk, but increase the yield of cheese from every one hundred pounds of milk, two pounds; in the saving of that amount of albumen, this being incorporated with the caseine. They claim not to use any chemical preparation in connection with the system and they might even increase this yield of cheese still more, but for the fact that a further increase of albumen causes the cheese to decay rapidly.

Mr. Pembleton, the proprietor of the creamery, says "that it was only after close investigation that he adopted this system, which he considers as much ahead of the centrifugal machines as the latter are ahead of the older systems."

The following is a summary of experiments made during the season of 1884, showing the yield per hundred, of milk, of butter and cheese.

Date.	Pounds Milk.	Pounds Butter.	Pounds Cheese.	Pounds Butter per hundred Milk.	Pounds Cheese per hundred Milk.	Total product.
June 22,	1058	$38\frac{10}{16}$	$82\frac{8}{16}$	3.65	7.79	11.45
" 27,	1297	$53\frac{14}{16}$	$90\frac{4}{16}$	4.15	6.95	11.11
July 4,	1404	53	101	3.77	7.19	10.97
" 18,	779	$30\frac{12}{16}$	$51\frac{8}{16}$	3.94	6.61	10.55
" 25,	698	$29\frac{8}{16}$	53	4.226	7.593	11.819
" 28,	812	$31\frac{9}{16}$	$65\frac{12}{16}$	3.88	8.09	11.98
" 31,	903	$34\frac{11}{16}$	63	3.84	6.97	10.81
August 1.	700	$30\frac{9}{16}$	55	4.366	7.827	12.223
" 2,	702	$27\frac{14}{16}$	$52\frac{6}{16}$	3.97	7.46	11.43
" 5,	676	$22\frac{5}{16}$	$52\frac{12}{16}$	3.30	7.80	11.10
Sept. 13,	565	26	$50\frac{3}{16}$	4.60	8.88	13.48
" 14,	590	$28\frac{2}{16}$	$47\frac{8}{16}$	4.766	8.05	12.816
" 15,	577	$24\frac{4}{16}$	54	4.202	9.359	13.561
October 5,	833	$34\frac{3}{16}$	71	4.10	8.52	12.62
" 9,	774	24	$67\frac{12}{16}$	3.10	8.74	11.84
" 10,	568	$19\frac{4}{16}$	$53\frac{4}{16}$	3.39	9.37	12.76
" 11,	581	$20\frac{1}{16}$	$52\frac{2}{16}$	3.45	8.97	12.42
" 12,	500	$24\frac{6}{16}$	55	4.875	11.	15.875
" 14,	486	$16\frac{12}{16}$	65	3.446	13.16	16.606
" 15,	619	$20\frac{2}{16}$	64	3.25	10.33	13.59
" 18,	851	$42\frac{6}{16}$		4.98		
Nov. 13,	784	$31\frac{10}{16}$	$73\frac{8}{16}$	4.033	9.375	13.408
" 15,	109	$7\frac{1}{16}$		6.479		
" 26,	1168	47	} 352	4.02	} 10.74	
" 27,	1177	$45\frac{8}{16}$		3.90		
" 28,	1136	$44\frac{12}{16}$	132	3.93	11.61	15.54
" 29,	664	$26\frac{4}{16}$	78	3.944		15.690
The last four days.	4145	$163\frac{8}{16}$	462	3.944	11,146	15.09

Average of 27 tests butter, 4.057 pounds per hundred milk.
Average of 25 tests cheese, 8.996 pounds per hundred milk.
Total product of 25 tests butter and cheese, 12.922 pounds per hundred.

The following is a summary of a series of carefully conducted experiments for the season of 1884, from native cows' milk, from August 1st:

General average per hundred pounds milk in *August*;
Pounds Butter, 3.88; pounds Cheese, 7.73; Total product, 11.61 pounds.
General average per hundred pounds milk in *September*;
Pounds Butter, 4.52; pounds Cheese, 8.76. Total product, 13.28 pounds.
General average per hundred pounds milk in *October*;
Pounds Butter, 3.82; pounds Cheese, 10.01. Total product, 13.83 pounds.
General average per hundred pounds milk in *November*;
Pounds Butter, 4.38; pounds Cheese. 10.87. Total product, 14.80 pounds.

There were also two tests made for butter alone, one from *Jersey* milk, the other *Native* cows' milk, on pasture feed, which gave: *Native* milk, per hundred, **4.98** pounds; *Jersey* milk, per hundred, **6.48** pounds.

I have no reason to doubt the statement of tests made.

Hearing so much in favor of it, I embraced an opportunity offered to inspect the entire process, and can say that I am not only favorably impressed, but feel that it may largely revolutionize the factory methods of butter-making.

The process is a combination of two previous methods tried long ago. These were the rapid heating of the milk in the open air, to drive off all odors, and the raising of the cream while cooling, and the vacuum process, so called, by which the cream was raised in the churn, which was also defective. This combination seems to remedy previous defects and, as far as I can see, commends itself to the producers of butter and cheese.

1. It can be advantageously used in the warmest as well as coldest weather.
2. It requires less expenditure of ice than most methods of setting, as the whole cream raising process is done while the milk is cooling.
3. The butter is of the best quality, and the cheese desirable.
4. The work is much less, hence the cost is in every way decreased.

I believe it worth while for those interested in factories, to examine fully this method, as, if it is all it promises, it is the desirable means whereby the best results may be accomplished.

Address the Powell Manufacturing Company, Burlington, Vt., for further particulars.

[PRINTED BY DIRECTION OF THE GOVERNOR.]

REPORT TO GOV. SAMUEL E. PINGREE,

UPON THE CATTLE DISEASES AT CAMBRIDGE, AND REMARKS THEREON.

By Dr. Hiram A. Cutting.

To His Excellency, SAMUEL E. PINGREE,
Governor of Vermont.

Sir:—Agreeable to your direction, I visited Cambridge, Vt., January 6th, 1885, and, as you require immediate report, I send this preliminary statement this evening, to be followed by further facts as fast as I am able to obtain them by microscopic investigation or otherwise.

THE OUTBREAK

was in the herd of William Prentice of Cambridge, who moved into town from Milton about one year ago. He had a herd of thirty-six head, a part of which he brought with him, and a part of which he purchased in the vicinity, but no recent purchases had been made. On December 5th, one of his oxen was taken purging severely. This purging was worse at commencement, but continued up to the time of his death. The last day it was a bloody discharge. He died the third day. The 8th, a cow was taken, the 12th, two more, and so at intervals of two or three days until one yoke of oxen, twelve cows and one bull have been taken. Ten have died and two have been killed a few hours before death to gain better advantage from a *post-mortem*, and three of the sick, having lived beyond the ominous three days, may possibly recover. Two of them have died within forty-eight hours from the first symptom of sickness.

SYMPTOMS.

Great heat in the head, staring coat, eyes and eye-lids red and slightly swollen, weeping constantly. They lie down for a time and then stand. When standing the head is moved slowly from one side to the other, with nose slightly extended. Much mucous runs from the nose, and breathing increased about one-third in frequency, being labored and with some noise in the nostrils. No appetite, and but little water is taken. Cows give usual amount of milk up to the hour of sickness, and then rapidly shrink, becoming dry in about twenty-four hours. They almost entirely lose their sight in the same time. Those still living are nearly or quite blind, the iris of the eye becoming milky in appearance, the white shreds extending over the entire dark surface, the white of the eye being quite red. In some there has been purging, as in the first case, but in others the bowels have remained in good condition, but the head symptoms are constant. They die insane and with spasms, having a bad smell as soon as dead. As the sickness increases they drop their head quite low, but retain the slight elevation of the nose. The indications are that there is great pain in the head from beginning to end.

TREATMENT.

Mr. Prentice treated the first, giving soot mixed with boiled flour, charcoal, tea made from hemlock bark, etc. The animals thus treated were taken scouring, and the medicine given seemed to pass through the system without any change. More recent cases have not scoured as the first did. Mr. Prentice then obtained the services of Frank M. Nichols, of St. Albans, a man of considerable repute as a farrier and cattle doctor, though my confidence was shaken in his ability by his refusal to divulge his treatment. From observation I should presume he did no damage, and the death rate did not denote much success. The medicine he called homœopathic, and gave fifteen drops now and then on the tongue. I noticed his trunks of medicine had anything but a homœopathic smell, and were suggestive of aloes and other medicines usually dealt out by the cattle doctor. As those I saw sick did not and had not purged, and as the secretions of their kidneys and bowels were normal, I recommended pulverized lobelia to be blown up the nostrils to clear the nasal passages, oil to be put on the top of the head where so hot, and warm embrocations to be put about the throat when it seemed that soreness there prevented deglutition.

SANITARY CONDITIONS.

I found the stables well ventilated, whitewashed, and with proper disinfectants used. Nichols seemed careful and trustworthy here. But the sick were in the same barn with the well, and I recommended, as there were two barns some thirty rods apart, that the sick and convalescent be put in one, and the well in the other, as most conducive to the health of the survivors.

POST–MORTEMS.

Dr. Nichols found tongue, throat and head diseased, food in stomach hard and dry, intestines red, filled with mucous and putrescent. In some there was ulceration. One first killed bowels not bad, but tongue, throat and head diseased. Examination by myself was of a two-year-old bull killed. Internal organs of the chest and abdomen all found to be healthful, as far as I could see. Parts were reserved for microscopic examination. Blood coagulated immediately after leaving the body. Throat showing some inflammation. Nasal cavities in high state of inflammation. Brain congested and yellowish, softened in parts of the white substance. Blood clot in brain, but probably the result of the concussion when knocked down. Optic nerve diseased and eye whitish and opaque like all. Temperature before death taken by Dr. Nichols, 105½ degrees; pulse, 93.

WATER FOR HERD.

This is supplied from springs and appears to be unexceptionable. Surroundings, as far as can be seen, dry and all right.

FEED.

This was corn fodder, early cut oats, unthreshed, and early cut hay; being a good mixture of clover, herdsgrass and red top, well cured and free from dust. Chaff collected for examination for ergot and other fungi.

CHARACTER OF DISEASE.

This disease has every characteristic of an epizootic, and not of contagion. They have not been taken sick in classes at regular intervals, but almost every day. It is liable to spread as all epizootic diseases are, and may result in a certain amount of contagion which has not yet developed. History tells us that it has often been a regular pestilence, and yet oftener is confined to a few outbreaks. Its fatality will doubtless diminish. The nearest description I find to this occurred a few years since at Portage county, Ohio, and gradually subsided. It was supposed that it originated from ergot in June grass. Further examination is needed to determine this, as no close examination has yet been made of the chaff from the hay fed here.

FUTURE EXAMINATION.

I would respectfully report further that I have examined the hay and find but little ergot, not enough to do any injury. The microscopic examination confirms all I wrote you, and shows in addition that the lung contains numerous *strongyli micrurus*, which doubtless caused the outbreak, and the enfeebled condition and predisposition to take cold rendered a cold fatal and probable. I think the actual loss by death nearly over, but his whole herd of cattle are of course diseased and liable to contaminate all they come in contact with. I do not think this *strongyli* the whole cause of death, but that the weather that predisposes to influenza caused, with these worms, such an inflammation as affected the brain; yet why it did not cause pneumonia instead, is indeed a mystery. A cold usually does, but the peculiar winter must have an effect, as I cannot account for disease of brain otherwise. I believe the great fatality in that herd ended, but the greatest care is needed not to contaminate other cattle. Many young cattle die of the worms only, as it is a dangerous disease. Mortality in this herd seemed confined to the youngest cattle.

REPORT UPON THE STRONGYLUS MICRURUS.

Having been requested by the Vermont Medical Society, at their annual meeting in 1880, to investigate and report upon an outbreak of pleuro-pneumonia at Fairlee, Vt., a part of which report I here give, I would first state the case as presented before the society. August 1st, 1880, Gardner S. Melendy, of Fairlee, purchased, in Cambridge, Underhill, Fairfield and Fletcher, forty-three calves and thirty-three yearlings, many of them being pnrchased near the Prentice farm in Cambridge.

Driving them home (he arrived August 14th), they were turned into a mowing lot near his house, a dry upland, with good feed. After a few days he drove twenty to a pasture a mile away, and ten into a pasture two miles away, and a week later he put twenty-five calves into a mowing field on the same farm. On September 8th, he found a yearling sick in the pasture and drove him home. His eyes were sore and running, as were also his nose and mouth; respiration rapid, with frequent coughing, discharging, when he coughed, much offensive matter. This yearling lived until the 12th, when he died. A week later a calf in the home field was likewise taken sick, having the same symtoms for four days, and died. A week later he was told that a yearling was dead in the pasture, which he found true, and that several more were coughing, and a few days later others had died. October 8th, six had died, and eighteen more had the disease. At this time he was alarmed, and it seems from good cause, and Mr. O. M. Tinkham made a post-mortem examination, and found the lungs badly congested and the air passages filled with small white thread-worms from one to two inches in length, and that their number was countless. This proved to be the *strongylus micrurus*, and is the entire cause of the disease. It is described by Cobbold, and is alluded to by Siebold in his work on entozoa. In 1833 there was a curious epidemic from this cause in England, destroying many cattle, especially calves and yearlings. A description of the same may be found in the Veterinarian, volume 6. In Guy's hospital report for 1836 the disease is described as causing symtoms exactly identical with what occurred at Fairlee, and thousands of cattle died. In 1840 they were found by Wyman infesting cattle in Connecticut, and were confounded with *strongylus filaria*, a similar worm infesting the lungs ot sheep. His description may be found in the American Journal of Science, volume 39. In 1843 J. B. Simonds described an epidemic among young cattle caused by worms in bronchi, which were also found in the bladder and intestines, with symptoms exactly as found in our case. His paper was published in "Transactions of the Veterinary Medical Association," published for that year.

In 1845 calves and young cattle died from this disease in France, under the same symptoms. It was epidemic and incurable, and thousands perished.

In 1848 it was equally epidemic in England, and is described in volume 21 of the Veterinarian. But great benefit was derived from nasal inhalation of either, chloroform. oil of turpentine and rectified oil of amber.

In 1649 it was described by J. G. Sandie, who says the same parasite infests sheep.

It was again epidemic in 1851, and benefit was derived from inhalation of sulphuric acid vapor, and from taking oil of turpentine in one-ounce doses.

In 1868 this disease was first observed in New York. It broke out in a herd belonging to Mr. Wood of Woodville. His herd was isolated, and the infected kept away from others. The disease was controlled in that place only to break out with great violence in Alleghany county, New York, in 1870. The cases were examined by Thomas L. Harrison, secretary of the state agricultural society, and an interesting account of them was published in the journal of that society in 1871.

In the same year there was another outbreak of this parasitic disease in Seneca county. Several cases were fatal, but as the authorities had full control and all cattle belonging to infected herds were isolated, it did not spread to any extent. It was, however, noticed that all the poultry upon the farm died from "gapes," showing that this species of worm, if not identical with the species causing "gapes" in chickens, is at least capable of doing the mischief.

But without referring further to special cases, I would say that it is the great cattle plague of Holland and Germany, as well as England and France, and some authorities say that in the low meadows of Hammersmith, England, where cattle do not thrive, even donkeys which feed there have numerous specimens in their lungs when killed, and the pheasants in that vicinity nearly all die with the "gapes."

It would be supposed that so fearful and often incurable a disease would have a history of its rise and progress; but such is hardly true of this parasite, and even its habits are not well understood. In England it is said to have originated in Cuba, while here it is spoken of as a disease of European origin. Some say one thing of the parasite, and others talk or write exactly opposite. Some say it is more likely to be epidemic in a wet season, others in a dry one, and while I show full deference to authority, I shall describe the strongylus micrurus as appears evident to me to exist in this section. I first became acquainted with them by finding them about sedge roots in wet ground, as microscopic worms. I am not sure upon what they feed, but have noticed a fine brown sediment in their intestines, which I believe to be vegetable matter, though they thrive best, producing most and growing the largest, when in the bronchial tubes of the calf. I have no doubt but that they attack the ox, horse, mule and poultry, as well as most wild animals, but the great fatality is among cattle. The numerous cases of "heaves" in horses, unaccounted for by overdraft or other disease, may largely owe to this worm their commencement.

FROM VERMONT TO NEW HAMPSHIRE.

This disease was carried from Vermont to New Hampshire in 1885 and I publish the report of Dr. Irving A. Watson, secretary of the State Board of Health, upon the cattle diseases at Strafford, which was as follows:

About the middle of last month, February, I received information by telephone that a disease had appeared among a herd of calves owned by Mr. W. Everett Hill of Strafford, and that nine had already died. A day or two subsequent to this, I made a visit to the locality for the purpose of learning the character of the disease, and to investigate, as far as possible, all the circumstances in the case. I found about fifteen calves sick at a barn on a farm which Mr. Hill owns a mile or so from his home place. The following history was obtained: In October last a gentleman living in Strafford went to northern Vermont, and bought a herd of fifty-two calves and brought them by rail to Penacook, from which place they were driven to Strafford. Out of this herd Mr. Hill purchased thirty, and immediately put them into a field of good fall feed. The balance of the herd was disposed of, so far as could be traced, in the towns of Strafford, Northwood and Barnstead. Out of the thirty which Mr. Hill bought he subsequently sold, or traded, nine, one of which died in a week or two. Very soon after the purchase it was noticed that one or two of the calves did not appear well, and in a few weeks it was noticed that most, if not all, of them were ailing. The first death occurred in December, and the others at intervals of about two weeks.

APPEARANCE.

The symptoms were such as to lead an attending veterinarian to believe it was anthrax, or blackleg. The calves were much emaciated, hair rough, eyes dull, slight nasal discharge, some cough, accelerated pulse with swelling of legs, especially about the ankles. In one instance an open sore appeared at the ankle joint. In one or two cases death was sudden without any appearance of prior sickness. Indurations were felt under the skin along the neck. As the animals were frozen solid, there was no opportunity to make a post-mortem examination. The owner was informed that every indication pointed to an infectious disease, and was ordered to bury at once all the dead animals, and to keep his entire stock secluded from all others. The selectmen of the town were directed to quarrantine the cases, as provided by law, and to take every precaution necessary to isolate the disease.

Dr. H. A. Cutting of Vermont was conferred with, and gave directions for examination of their lungs, as he believed it was *strongylus micrurus.*

A SECOND VISIT

was made to the herd March 14th. Six more had died making in all fifteen deaths, which had reduced the infected lot of calves to nine. These appeared as upon my first visit, except that they were more debilitated if anything, being poor and standing with feet much nearer together than natural. All coughed and had a discharge from the nose. A scaly condition of the nose just at the edge of the hair, having a scrofulous appearance, was noticed in every case. Inquiry showed that the calves had been well cared for during the entire winter, and in addition to all the hay they required, about four quarts of shorts was fed to each, daily, through the winter. They have also had an occasional feed of potatoes and a little corn.

Good ventilation has been constantly assured by reason of many cracks caused by the shrinkage of the boards of the barn, yet they were reasonably protected from the cold by the situation of the pen or stalls. This disease was correctly diagnosed through a post-mortem examination of one of the creatures on Saturday, March 14th.

The cause of the disease is a parasite infecting the lung, known technically as the s*trongylus micrurus.* The disease might in common parlance be called the "lung-worm disease," and is of a very infectious and contagious character. So far as I can ascertain, these are the first cases positively known in the State, and the matter becomes of great importance, inasmuch as it is possible that other herds in Strafford, Northwood and Barnstead, are already affected.

POST-MORTEM EXAMINATION.

The post-mortem examination was made upon one of the best looking calves in the lot, which was selected for the purpose and killed by a single blow without bleeding. A portion of the body was skinned, including one hind leg. At the ankle and gambrel joint the tissues were found infiltrated with serum and extravasated blood, showing that the blood vessels at these points had given way or become so degenerated as to allow the serum and blood to escape into the surrounding tissue. The contents of the abdominal cavity appeared to be normal, with the exception of a general anæmic appearance. Upon opening into the thoracic cavity a small amount of fluid (serum) was found. In the pericardium (heart-sack) there was a large amount of fluid. The heart was in all respects normal, the valves perfect and the substance firm and natural. The lungs at once attracted attention by having the appearance of a lung affected with pneumonia. There were hepatizations almost precisely resembling the latter disease. Upon cutting into the lung, after its careful removal, a large portion was found to be indurated and solidified, presenting nodules of varying consistency. This condition was brought about through a probably low grade of inflammatory action caused by the parasite, in which lymph was thrown out so as to occlude the air cells. This condition was found in spots varying from the size of a pea to portions half as large as the hand. Upon cutting across some of the bronchi, or lung tubes, these worms were discovered—some of the tubes being literally filled with them, and they could be taken out in rolls of probably a dozen or more. These pests had evidently made a slow progressive attack upon the lungs and the animals had been failing in an exact ratio to the progress made by the parasitic disease in the lungs. The gradual loss of of healthy lung surface had, through the lessened aeration of the blood and the reflex action, produced by the constant irritation, caused the constitutional disturbances mentioned above.

NATURE OF THE DISEASE.

The parasite which produces the disease is the *strongylus micrurus.* There are other varieties of the same family, as the *strongylus filaria,* which infests the lungs of sheep and which has proven a very serious disease in England; the *strongylus elongatus* equally fatal in the hog. Another variety of this family known as the *strongylus eontortus* or *lombriz,* has for its habitat the fourth stomach of the sheep and causes great destruction in some seasons in the Southwest. The *strongylus long evaginatus* was found in the lung of a boy by Dr. Jortsits at Clausenburg, and Ziemssen reports this as the only case on record.

The variety which causes the disease under consideration, when full-grown, is a thread-like worm about the size of a fine sewing-needle, the females, however, reaching a length of two inches or more, while the males are somewhat shorter—from an inch to an inch and a half. Their most congenial habitat seems to be the bronchial tubes of the calf, extending into the ramifiations of the bronchi, even into the tubes that are so small that a single worm will completely occlude them. The eggs are deposited in these tubes in great numbers, and through the coughing of the infected animal the nasal discharges are deposited in the feed, in the stalls or watering-troughs, about the yard, field, or wherever the creature may be. If deposited where there is moisture, as in the watering-trough, wet lands, or on the grass that is wet by rain or dew, they hatch in a few hours. Dr. H. A. Cutting, of the State Board of Agriculture of Vermont, hatched the eggs, experimentally, in water in two hours, even after they had been kept in glycerine for two weeks. On the other hand it is said that if the eggs are deposited in a dry place they will become perfectly dry, and retain their vitality for an indefinite period (in one instance for three years), ready to spring into life at the first favorable opportunity.

The embryo of this parasite is taken with the food or drink into the stomach of the animal, from whence it makes its way directly through the walls of the stomach into the circulation, and reaching the lungs becomes encysted in its substance, where it may remain a considerable length of time before maturing. The eggs are sometimes deposited in a sack or cyst in the lung tissue as well as in the bronchial tubes, and are subsequently hatched, adding colony after colony to perhaps the already great numbers that are making an attack upon every portion of the lungs.

When the females are dislodged from the lung, as in the act of coughing, they are filled with thousands of eggs which, whether being immersed in water or dried, retain their life and are ever ready to infect other cattle. They live in water or about the moist roots of grass for a long time after being hatched.

Thus it will be seen that the disease is a very difficult one to eradicate, and it is a matter of much public concern, especially to the stock-producing portion of the community. No one knows when a locality once infected will again be free from a liability to this disease. It may live in the water supply, the moisture of the yard, the soil, or in the impalpable dust of the stable.

WHERE THE DISEASE CAME FROM.

There is no doubt that the disease was brought from Vermont, the purchaser making, it is stated, his headquarters while buying at or near St. Albans, which is in the infected district, and near the towns of Cambridge, Underhill, Fairfield and Fletcher.

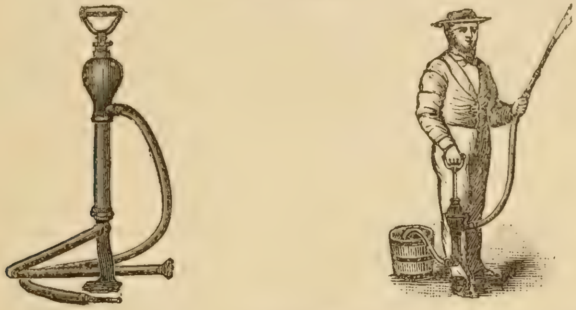
WHAT VERMONT SHOULD DO.

Is there any doubt but what this state should provide, through a contingent fund in the hands of the governor or otherwise, for the proper management of this and other dangerous diseases? But we leave it in the hands of the legislature, for "a word to the wise is sufficient."

FARMING TOOLS AND OTHER IMPLEMENTS.

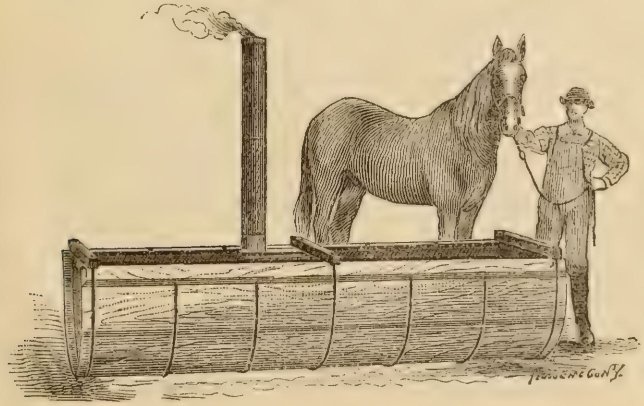
Many farming tools have been examined and tested the past two years, and it is only just to the farmers that I report upon such as seem best for the money, as all do not have a chance to try various kinds before purchasing.

FORCE PUMPS.



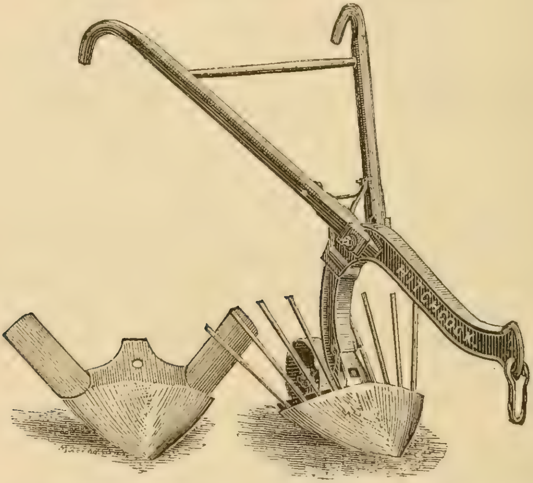
The garden force pump is today almost an indispensable article on the farm and in the garden, as it is used for so many purposes. To spray trees with liquid insect destroyers, to water gardens, to wash carriages and windows, and though I mention it last but not the least of its value, is to quench fires. Many a farm-house has been saved by the convenient hand force pump. After using various patterns, I am free to say that the most convenient one I ever used is what is called the Huntington pump, manufactured by the Challenge Pump Co., Swanton, Vt.

WARM WATER TANK FOR CATTLE.



All farmers, I think, concede the fact that ice cold water in winter is not desirable for stock, especially for milch cows. Various devices have been made and several have been patented, whereby the water for cattle may be warmed in the tank or trough from which they drink. Last winter I experimented with one made by Adams & Haynes of Wilmington, Vt., and I find it a success. Cobs soaked in kerosene oil answered best in my experiments as fuel, but fine wood or kerosene oil and sawdust did finely, and though the tank I had was a large one, from fifteen to twenty minutes were sufficient to warm the water sufficiently, even when it was frozen over; and that, too, without danger from fire. This heater can be put into a trough made on the premises, or they manufacture and sell the entire arrangement all complete. Their prices range low for the worth. It is indeed a valuable acquirement. Other parties manufacture something for the same purpose, but as none have seemed willing I should test their heaters with this, as I have asked them to do, I feel as though the one I have used was probably as good, if not better than any other.

POTATO DIGGER AND SHOVEL PLOW.



When I was a boy, a cast iron shovel blade like the shovel cultivator was cast with slots running through it, yet none coming out at the edge, and called a potato digger. Though it was so simple it really was quite a digger, yet it did not sell and few were made. Last year there came to my notice a combined shovel plow and potato digger that seemed a well devised improvement on the potato digger of my boyhood. I ordered one, and by use I find it a success. This implement, though very simple in appearance is, I believe, as near perfect as can be attained and come within the reach of every farmer. By the changing of one bolt it may be converted either into a shovel plow or a potato digger. The fingers are adjustable, being held in position by the plow point. Thus, in case of breakage, a new part may be inserted without the expense of a whole new head. The fingers, points and wings are made of steel, rendering it light, strong and durable.

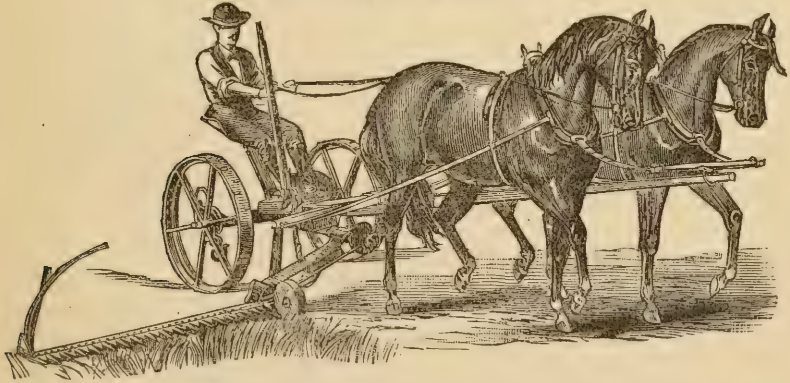
It is designed for the various kinds of soil. When sandy it works best as shipped from the factory. But when the soil is loam and heavy, changes become necessary to insure success in its working. Full directions are with every digger, showing how those changes are made. As a shovel plow it is valuable for cultivating all kinds of crops that are planted in rows or drills.

The wings and points are made of steel, polished and ground sharp. The wings are twisted in the shape of the mould-board of an ordinary plow, and in operation turn off the loose, mellow soil toward the plants, and against them if desired. The wings are adjustable, can be opened or closed to throw off more or less earth, and to adapt them to rows of greater or less distance apart.

For weeding, and when it is not desired to make any furrow or throw any soil against the plants, the wings should be changed or reversed. The soil then is not thrown to the sides, but passes over the plow, and is left in a pulverized and loose state, and as the wings present a sharp, cutting edge, it thoroughly cuts up all grass and weeds. The depth of the cut is regulated by the raising or lowering of the wheel and draft hook.

The handles are adjustable to a tall or short man. I find also that the Yankee Swivel Plow is one of the best swivel plows made, or at least is very desirable. Both are manufactured by the Belcher & Taylor Agricultural Tool Co., Chicopee Falls, Mass.

THE BUCKEYE MOWER.



Like sewing machines many mowers do good work, and it is natural that every man owning and using any special machine should think his the best. I have had many inquiries about those machines, and so I feel I was expected in some way to decide. At least I wanted the best myself. After various tests on draft and work, especially on rough ground, I settled on the Buckeye, manufactured by the Richardson Manufacturing Co., Worcester, Mass., and my men as well as myself are satisfied with it. I believe it one of the best mowing machines in market.

HAMMOND'S SLUG SHOT.

In this time of insect war, when every man must be a warrior and use the best thing possible to defeat the common enemy, I believe all are interested in knowing what is effective. I find the Slug Shot, manufactured by Benjamin Hammond, Fishkill on Hudson, N. Y., a valuable insect destroyer. It is cheap and efficient. If not entirely harmless to man and animal, so near so that in its use there is no danger, as there is from Paris green and other virulent poisons. I have given directions how a valuable insectator can be manufactured, but I am aware that few will manufacture for themselves, hence if purchases are made it is desirable to buy the best. In case of purchasing I think the "Slug Shot" a reliable and efficient insect destroyer.

THE YELLOW DOCK PULLER.

The yellow dock, a noxious weed, seems increasing in the state, and it is one of the hardest to eradicate from meadows of any I am acquainted with. I accidentally found a forked instrument something like the claw of a hammer, only it has a fulcrum and a spade handle. It can be crowded down one side of the root and fetch it every time, and to me is a valuable acquisition. It will also take out the burdock and all roots of like character. I have no knowledge of the manufacturer, and cannot tell where it can be purchased, but I advise farmers having such roots in their land to be on the lookout for one.

INDEX.

Acer.. 46
Acts of planted seeds.................................... 16
Adaptation of trees to different situations.................. 16
Advantages of vacuum process........................... 158
Age of trees by grains.................................. 41
Alder..56, 63
Alnus... 63
Amelanchier.. 50
American elm... 58
American linden... 44
Ammonite, analysis of.................................. 118
Amount of sap-flow...................................... 75
Ampelopsis.. 44
Analysis of fertilizers..................................133, 135
  " of fertilizing material............................ 117
  " of maple sap......................................80, 95
  " of " sugar.. 83
  " of " syrups... 83
  " of stable manures.................................. 110
  " of woods.. 17
Andromeda.. 55
Apple pomace, analysis of.............................. 121
Arrow-wood.. 53
Ash... 57
Ashes, worth of.. 114
Aspen... 64
Average yield of sugar from maple groves................... 100

Basswood.. 44
Bastard maple... 47
Berberis.. 43
Better arrangements.................................... 155
Betula.. 62
Birch... 62
Bird-cherry... 48
Blackberry.. 49
Black birch... 62
  " cherry.. 48
  " hickory... 59
  " spruce.. 67
Blueberry... 55
Boiling sugar... 74
Boneblack, analysis of................................. 119

Brown ash........ 57
Buckeye mower........ 171
Buckthorn........ 44
Butter-hickory........ 59
Butter-making by vacuum process........ 157
Butternut........ 58

Cambridge cattle-disease, outbreak of........ 161
Canada plum........ 48
Capital in lumber business........ 26
Care of young trees........ 34
Carga........ 59
Carpinus........ 61
Cassanda........ 55
Castanea........ 61
Cattle-disease at Cambridge........ 161
" " epidemic........ 164
Cattle-disease in New Hampshire........ 165
" " report on........ 161
Ceanothus........ 44
Cedar........ 68
Celastrus........ 44
Celtis........ 58
Cephalanthus........ 54
Champion evaporator........ 74
Character of cattle-disease at Cambridge........ 163
Chestnut........ 61
Choke-berry........ 48
Choke cherry........ 48
Climbing bitter-sweet........ 44
Commercial fertilizers, value of........ 129
Common barberry........ 43
Common salt........ 113
Composition of maple sap........ 79
Composting by hogs........ 116
Comptonia........ 62
Constituents of maple sap........ 97
Cotton-seed meal, analysis of........ 120
Cornus........ 52
Corylus........ 61
Cradagus........ 50
Cranberry........ 54
Culture and management of our native forests........ 17
Culture, when seeds grow........ 36
Currants........ 51

Decrease of water........ 5
Demand and price of lumber........ 25
Diervilla........ 53
Dogwood........ 52
Dwarf cherry........ 48

Effect of cutting forests........ 4
Effect on maple trees to tap........ 91
Elder........ 53
Elm........ 58
Experimental farm work........ 104
Experiments, results of........ 127
“ manner of conducting........ 126
“ on maples........ 75
Export of lumber........ 27

Facts about trees........ 71
Fagus........ 60
Farmer's family........ 149
“ food........ 148
“ girl runs away........ 153
Farming tools and other implements........ 169
Fertilizers, gain and loss determined........ 128
“ manner of application of........ 125
Fertilizing maples........ 75
Fir........ 67
Fish-waste, analysis of........ 117
Food for farmers........ 148
Force-pump........ 169
Forest commissions........ 5
“ “ of New Hampshire........ 6
“ economy necessary........ 25
“ of Vermont........ 3
Fox-grape........ 43
Fraxinus........ 57
Fuel, value of wood for........ 42

Gain and loss by use of fertilizers........ 128
Gaylussacia........ 54
Gooseberry........ 51
Governor Furnas on age of trees........ 41
Graphical chart........ 7
Gray birch........ 62
Great profits of timber investments........ 13
“ “ of tree culture........ 14
Ground bone, analysis of........118, 120
“ hemlock........ 69
“ horn........ 118

Hackberry........ 58
Hamamelis........ 51
Hammond's slug shot........ 172
Hardhack........ 49
Hardships of farmers' wives........ 150
Hazel........ 61
Hemlock........ 68
Hen-manure........ 108

High cranberry.. 54
Home-made fertilizers, how made........................ 121
Honeysuckle... 53
Hornbeam.. 52
How to obtain seeds of trees.......................... 69

Ilex.. 56
Injury by wind.. 24

Juglans... 58
Juniperus... 68

Kainit.. 115
Kalmia.. 56
Kieserite, crude...................................... 113

Land plaster and analysis.............................111, 112
Larix... 68
Laws to protect forests............................... 70
Lever-wood.. 61
Lime, analysis of..................................... 117
Lindera... 58
Lists of maples, experiments on.......................91, 92, 93,
Locust-trees.. 47
Logging in Essex county............................... 27
Lonicera.. 53
Lumber, demand and price of........................... 25
" exports of.. 27

Manner of application of fertilizers.................. 125
Manufacture of maple sugar............................ 101
Manure at surface..................................... 125
" from night-soils.................................... 105
" on the farm... 105
Manuring maples....................................... 75
Maple flavor from butternuts.......................... 82
" sap, analysis of.................................... 80
" sugar, analysis of.................................. 83
" sugar industry...................................... 72
" syrups, analysis of................................. 83
Meteorological conditions best for sap-flow........... 89
Mrs. Tucker dies...................................... 154
Moose-wood..47, 58
Mountain ash.. 50
" laurel.. 56
" oak... 60
Mulberry.. 49
Mulching.. 22
Myrica.. 61

Natural and improved growth of trees.... 19
Nature of cattle-disease.... 167
Nemopanthes.... 56
Nitrate of soda, analysis of.... 117
Nyssa.... 52

Oak.... 59, 60
Observations of T. Wheeler.... 75
“ on rainfall.... 3
Ostrya.... 61
Our homes.... 145
Outbuildings handy.... 146
Per cent of sugar in sap.... 78
Perfect health, how obtained.... 145
Picea.... 67
Pig-walnut.... 58
Pine.... 66, 67
Pinus.... 66
Pitch-pine.... 67
Planting to stand.... 38
Platanus.... 57
Poison ivy or poison oak.... 45
Poplar.... 65
Populus.... 64, 65
Post mortem in cattle-disease.... 162, 167
Post spout.... 73
Potato digger.... 170
Present demand for maple sugar.... 102
Prices of fertilizing materials.... 131
Prickly ash.... 43
Prof. C. E. Bessey on annual tree-growth.... 41
Prunus.... 48
Pyrus.... 50

Quercus.... 59

Rainfall at Concord....
“ at Hanover, N. H....
“ at Lunenburgh.... 7
“ at Mt. Washington.... 7
“ at Weirs, N. H.... 7
“ at Woodstock.... 7
“ increasing on Mt. Washington.... 6
Raising trees from seed.... 28
Rapid growth of trees.... 15
Raspberry.... 49
Red ash.... 57
Red oak.... 60
Red pine.... 67
Reforesting with maples.... 75
Report on cattle-disease.... 161

Rhodendron.. 56
Rhumnus.. 44
Rhus.. 45
Ribes.. 51
River beech.. 61
Robinia.. 47
Rock maple.. 46
Rose.. 50
Rubus.. 49
Rules for trimming forests.. 23

Salix..63, 64
Sambucus.. 53
Sap-flow.. 86
Sap produced on different sides of maples.. 98
Sap-spouts.. 72
Sassafras.. 57
Scarlet or white maple.. 46
Scientific experiments with maple.. 77
Scrub oak.. 60
Season notes on sugar-making.. 94
Second-year treatment of seedlings.. 32
Seedlings, easily transplanted.. 37
" how treated.. 33
Seeds of trees, how to gather.. 69
Shad-bush.. 50
Shade trees about house.. 146
Shagbark hickory.. 59
Situation of trees that best run sap.. 87
Sleeping-rooms in farm dwellings.. 147
Small growth of trees.. 21
Soft, or river maple.. 47
Soil and situation.. 29
Soil for trees.. 17
Sources of maple sugar.. 84
" of nitrogen.. 117
" phosphoric acid.. 118
Sowing tree-seeds.. 30
Spice-bush.. 58
Spirea.. 49
Spruce.. 67
Stable manures composted.. 109
Staphylea.. 44
Stinginess in farmers.. 151
Strongylus micrurus.. 163
Sugar maples.. 46
Sugar plum.. 50
Sugar-seasons.. 88
Sumach.. 45
Summer grape.. 43
Summer in Michigan.. 27

Sweet fern.. 62
Sycamore 57

Table of rainfall at Lunenburgh........................... 8
" of rainfall on Mt. Washington and at Lunenburgh comp'd 9
" of temperature at Lunenburgh.......................... 11
Tamarack 68
Tapping maples...72, 90
Taxus 69
Temperature 10
Tendency to floods... 4
The box system... 35
The conifers... 33
The nursery.. 33
Thorn.. 50
Tilia 44
Timber investments best...................................... 12
" in waste places.. 16
Time to apply ferttlizers.................................... 125
Transplanting large trees.................................... 40
" trees.. 39
Tree culture... 20
" " for profit.. 12
" " in Vermont.. I5
" in beds.. 35
" in boxes... 35
" of Vermont... 43
Trimming trees... 41
Tsuga.. 68
Two Mrs. Tuckers... 150

Ulmus.. 58
Underbrush... 221
Unhealthy sleeping-rooms..................................... 147

Vaccinium.. 54
Vacuum process in butter-making, advantages.of............... 158
" " product of butter from.................................. 159
Value of fertilizers... 135
Value of wood.. 42
Variation of product by age of tree.......................... 89
Viburnum... 53
Vermont lumber business...................................... 26
" trees of... 43
Vitis.. 43

Walnut... 59
Warm water tank for cattle................................... 169
What seeds germinate... 31
Wheat bran, analysis of...................................... 120
Wheeler, Timothy, observations on maples..................... 75

White ash.. 57
  " birch.. 62
  " oak.. 59
  " or scarlet maple.. 46
  " spruce.. 67
Willow..63, 64
Winter grapes.. 42
Witch-hazel.. 51
Woodbine.. 44
Wood, value of.. 43
Worthless fertilizers.. 130

Yellow birch.. 62
  " dock puller.. 172

Zanthoxylum.. 43

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